

APPENDIX E

U.S. Forest Service – Manti-La Sal and Uinta-Wasatch-Cache National Forests Ecological Site Descriptions

1.0 ENVIRONMENTAL SETTINGS

1.1 Wasatch Mountains North Major Land Resource Area

In Utah, the TransWest Express Transmission Project (TWE Project) is in the Wasatch Mountains North Major Land Resource Area (MLRA) (MLRA-47X). Elevation ranges from approximately 4,900 (1,495 meters) to 13,500 feet (4,115 meters). The average annual precipitation in most of this MLRA is 15 to 30 inches (380 to 760 millimeters). It can be as much as 73 inches (1,855 millimeters) at the higher elevations. Peak precipitation occurs in the winter months. The higher elevations receive significant amounts of snowfall each year. The average annual temperature is 30 degrees Fahrenheit (°F) to 58°F (-1 to 15 degrees Celsius). The frost-free period averages 140 days and ranges from 60 to 220 days, generally decreasing in length with elevation. In the Wasatch Mountains North, about 22% of water is from groundwater sources, and 78% is from surface water sources. Low levels of salts occur in the groundwater closest to the recharge areas along the base of the mountains, while briny water occurs in the deeper parts of these deposits.

This region consists of diverse geology. The mountains in this MLRA are primarily fault blocks that have been tilted up. Alluvial fans at the base of the mountains are recharge zones for the basin fill aquifer and are significant sources of sand and gravel for construction. An ancient shoreline of historic Lake Bonneville is evident on the footslopes along the western edge of the MLRA. Rocks exposed in the mountains are mostly Mesozoic and Paleozoic sediments, but Precambrian rocks are exposed in the Uinta Mountains. The Uinta Mountains are among the few ranges in the United States that are oriented west to east. Younger igneous rocks (ash and lava) are found throughout the MLRA. Lava-capped mesas are common in the southern part of the area. The southern Wasatch Mountains consist of Tertiary volcanic rocks occurring as extrusive lava and intrusive crystalline rocks. The dominant soil orders in this MLRA are Aridisols, Entisols, Inceptisols, and Mollisols. The soils in the MLRA dominantly have a frigid soil temperature regime on plateaus and the lower mountain slopes and a cryic soil temperature regime at the higher elevations. They have a mesic soil temperature regime at the lowest elevations, on south-facing slopes. The soil moisture regime is typically xeric.

The composition of vegetation within this region varies with elevation. The zone above an elevation of about 13,000 feet (3,965 meters) supports alpine meadows. Coniferous forests of Engelmann spruce (*Picea engelmannii*), white fir (*Abies concolor*), subalpine fir (*Abies lasiocarpa*), and Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) dominate the mid to high elevations. The most common understory plants in these forests are Oregon grape (*Mahonia aquifolium*), Oregon boxleaf (*Paxistima myrsinites*), and heartleaf arnica (*Arnica cordifolia*). The part of the MLRA in the Uinta Mountains includes significant amounts of lodgepole pine (*Pinus contorta*), and the southern part of the Wasatch Mountains includes significant amounts of ponderosa pine (*Pinus ponderosa*). Forests of quaking aspen (*Populus tremuloides*) commonly have an understory that includes blue wildrye (*Elymus glaucus*), mountain brome (*Bromus marginatus*), Fendler's meadowrue (*Thalictrum fendleri*), and aspen peavine (*Lathyrus lanszwertii*). Bluebunch wheatgrass (*Pseudoroegneria spicata*), bearded wheatgrass (*Elymus caninus*), blue wildrye, mountain brome, and numerous forbs grow in the understory in areas of Gambel oak (*Quercus gambelii*), curl-leaf (*Cercocarpus ledifolius*) and birchleaf (*Cercocarpus betuloides*) mountain mahogany, common snowberry (*Symphoricarpos albus*), and serviceberry (*Amelanchier* spp.). Big sagebrush (*Artemisia tridentata*) and bluebunch wheatgrass are the dominant species in the sagebrush-grass plant communities that are common at the lowest elevations.

1.2 Great Salt Lake Area Major Land Resource Area

In Utah, the TWE Project is also located in the Great Salt Lake Area MLRA (MLRA-28A). Elevation ranges from 3,950 to 6,560 feet (1,205 to 2,000 meters) in the basins and from 6,560 to 11,150 feet

(2,000 to 3,400 meters) in the mountains. The average annual precipitation is 5 to 12 inches (125 to 305 millimeters) in the valleys and is as much as 49 inches (1,245 millimeters) in the mountains. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The driest period is from midsummer to early autumn. Precipitation in winter typically occurs as snow. The average annual temperature is 39°F to 53°F (4 to 12 degrees Celsius). The frost-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with elevation. Water is scarce in this region. For the most part, streams are small and intermittent and depend on sources in the higher mountains. Reservoirs are used to store water in the mountains east of this area for irrigation in the flatter areas of this MLRA.

The dominant soil orders in the MLRA are Aridisols, Entisols, and Mollisols. The soils in the area dominantly have a mesic or frigid soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are well drained or somewhat excessively drained, loamy or loamy-skeletal, and very deep. Calcixerolls formed in alluvium on alluvial fan remnants and lake terraces (Abela series) and in alluvium and lacustrine sediments on lake terraces (Collinston series). Moderately deep Haploxerolls (Middle series) formed in residuum on mountain slopes. Deep and very deep Haploxerolls (Ririe and Rexburg series) formed in loess and silty alluvium on fans, terraces, foothills, and basalt plains. Shallow Haploxerolls (Hymas series) to very deep Haploxerolls (Hondoho series) formed in colluvium and residuum derived from limestone on mountains and foothills. Torriorthents formed in alluvium on alluvial fans and beach plains (Cliffdown series) and in alluvium mixed with lacustrine sediments on alluvial flats and fans, lake terraces, and lake plains (Timpie and Tooele series). Poorly drained Aquisalids (Saltair series) formed in alluvium and lacustrine sediments on lake plains and basin floors. Torripsamments (Yenrab series) formed in sandy eolian material on dunes. Haplocalcids formed in residuum on hills and mountains (shallow Amtoft series); in alluvium and colluvium on alluvial fans, terraces, and hills (Hiko Peak series); in mixed alluvium and lacustrine sediments on alluvial fans, terraces; and lake plains (Taylorsflat series); and in lacustrine sediments on lake terraces (Thiokol series). Natrargids (Skumpah series) formed in alluvium on alluvial fans and flats.

This area supports desert shrub, sagebrush semidesert, and woodland vegetation. In areas where the average annual precipitation is less than about 200 millimeters, the soils support shadscale saltbush (*Atriplex confertifolia*), winterfat (*Krascheninnikovia lanata*), black sagebrush (*Artemisia nova*), and associated grasses, such as Indian ricegrass (*Achnatherum hymenoides*) and squirreltail (*Elymus elymoides*). Greasewood (*Sarcobatus vermiculatus*) and Nuttall's saltbush (*Atriplex nuttallii*) grow on soils having a high content of salts or sodium. In areas where the average annual precipitation is 200 to 300 millimeters, the soils support big sagebrush, shadscale, winterfat, and associated grasses, such as bluebunch wheatgrass, Indian ricegrass, and bluegrasses (*Poa* spp.). In areas where the average annual precipitation is more than 300 millimeters, the soils support Utah juniper (*Juniperus osteosperma*), singleleaf pinyon (*Pinus monophylla*), big sagebrush, bluebunch wheatgrass, bluegrasses, and needle and thread (*Hesperostipa comata*). A large, nearly barren area west of Great Salt Lake has a very sparse cover of pickleweed (*Salicornia* spp.), sapphire woollystar (*Eriastrum saphirinum*), seepweed (*Suaeda* spp.), and greasewood.

1.3 Ecological Site Distribution

Dominant ecological sites in the TWE Project right-of-way within the U.S. Forest Service Manti-La Sal National Forest (MLSNF) and Uinta-Wasatch-Cache National Forest (UWCNF) include Upland Stony Loam (Pinyon–Utah Juniper) (217.8 acres) and High Mountain Stony Loam (Conifer) (195.0 acres). Less prevalent ecological sites include Upland Loam (Basin Big Sagebrush) (7.4 acres) and Upland Stony Loam (Black Sagebrush) (8.9 acres) (Table E-1). A photograph of each ecological site is provided in Attachment E-1. Maps depicting the ecological site locations in the TWE Project right-of-way are provided in Attachment E-2.

TABLE E-1 ECOLOGICAL SITE DISTRIBUTION IN THE U.S. FOREST SERVICE – MANTI-LA SAL AND UNITA WASATCH CACHE NATIONAL FORESTS

Ecological Site	Managing Agency	Right-of-Way Area (acres)	Permanent Disturbance Area (acres)	Temporary Work Area (acres)
Mountain Loams		445	52	253
High Mountain Loam (Aspen)	USFS/BLM	65	12	15
High Mountain Stony Loam (Conifer)	USFS/BLM	201	37	110
Mountain Loam (Mountain Big Sagebrush)*	USFS/BLM	7	<1	6
Mountain Shallow Loam (Mountain Big Sagebrush)	USFS/BLM	136	1	93
Mountain Stony Loam (Antelope Bitterbrush)	USFS/BLM	1	<1	1
Mountain Stony Loam (Gambel Oak)	USFS/BLM	6	<1	7
Mountain Stony Loam (Shrub)†	USFS/BLM	29	2	21
Upland Loam (Basin Big Sagebrush)	USFS/BLM	0	0	0
Upland Loam (Bonneville Big Sagebrush)	USFS/BLM	0	0	<1
Upland Stony Loam (Black Sagebrush)‡	USFS/BLM	0	0	0
Stony Slopes		33	<1	19
Upland Shallow Hardpan (Pinyon-Utah Juniper)	USFS/BLM	5	<1	8
Upland Stony Loam (Pinyon–Utah Juniper)	USFS/BLM	11	<1	4
Upland Shallow Loam (Two-Needle Pinyon / Utah Juniper)	USFS/BLM	14	<1	6
Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon)	USFS/BLM	3	<1	2

* Includes 'Semiwet Fresh Meadow' ecological site.

† Includes 'Mountain Stony Loam (Mountain Big Sagebrush)' ecological site.

‡ Includes 'Upland Loam (Wyoming Big Sagebrush)' ecological site.

1.4 Rangeland Analysis Platform

RAP was used to further assess the distribution and estimated cover of vegetation and cover types across the Project (NRCS and BLM 2021). RAP integrates data from NRCS's National Resources Inventory and BLM's Assessment, Inventory, and Monitoring and Landscape Monitoring Framework datasets. These quantitative vegetative assessments are modeled with historical Landsat satellite records, gridded meteorology data, and abiotic land surface data to provide estimates of the percent vegetation cover of different growth forms. RAP data were used to define the vegetation and abiotic characteristics for the Project and to develop reclamation success cover standards for each ecological site and DRG, as defined in Table E-2.

TABLE E-2 DRG RAP ATTRIBUTE DATA FOR THE U.S. FOREST SERVICE – MANTI-LA SAL AND UNITA WASATCH CACHE NATIONAL FORESTS

DRG	ESD	Forbs and Grasses - Annuals (%)	Forbs and Grasses - Perennial (%)	Woody (%)	Litter (%)	Bareground (%)
Mountain Loams	High Mountain Loam	1.7	27.5	53.2	9.5	4.1
	High Mountain Stony Loam	1.3	39.5	46.6	6.3	2.9
	Mountain Loam - MBS	4.4	21.7	40.2	14.0	11.5
	Mountain Shallow Loam	4.0	19.1	41.4	13.2	12.2
	Mountain Stony Loam - Antelope Bitterbrush	4.4	22.7	42.5	13.1	8.8
	Mountain Stony Loam - Gambel's Oak	3.4	22.3	46.8	12.4	8.0
	Mountain Stony Loam - Mountain Big Sagebrush	3.1	17.5	45.0	14.0	10.1
	Mountain Stony Loam - Shrub	2.4	26.5	46.8	10.9	7.3
	Upland Loam - Basin Big Sagebrush	10.8	28.8	27.5	16.0	10.9
	Upland Loam - Bonneville Big Sagebrush	7.1	28.8	36.9	12.4	8.2
	Upland Loam - Wyoming Big Sagebrush	10.6	26.8	27.5	14.4	11.7
	Upland Stony Loam - Black Sagebrush	8.1	24.7	34.8	15.3	10.4
	Wetland & Riparian	5.3	19.6	42.9	12.1	8.7
	SUBTOTAL	5.1	25.0	40.9	12.6	8.8
Stony Slopes	Upland Shallow Hardpan	6.5	21.6	34.5	13.6	11.6
	Upland Shallow Loam - Two Needle Pinyon	3.0	17.0	49.4	11.4	8.3
	Upland Shallow Loam - Utah Juniper	3.3	21.1	44.4	13.9	10.2
	Upland Stony Loam - Pinyon-Juniper	3.8	16.7	42.4	14.5	10.7
	SUBTOTAL	4.2	19.1	42.7	13.3	10.2

Source: NRCS and BLM 2021

2.0 INDIVIDUAL ECOLOGICAL SITE DESCRIPTIONS (ADAPTED FROM NRCS 2020A)

2.1 High Mountain Loam (Aspen) Ecological Site Description

High Mountain Loam (Aspen) ecological sites in the TWE Project within the MLSNF and UWCNF occur on sloping to very steep mountain slopes, canyons, and glacial moraines. Slopes typically range from 3% to 70% (NRCS 2020a). Major soil series associated with High Mountain Loam (Aspen) ecological sites include Aagard, Senchert, Baird Hollow, Flygare, and Skutum. The climate in High Mountain Loam (Aspen) ecological sites is characterized by cold, snowy winters and cool summers. The average annual precipitation ranges between 24 and 34 inches. On average, the wet season is from October through April, and the dry season is typically from June through August (NRCS 2020a).

2.1.1 Soil Characteristics

High Mountain Loam (Aspen) ecological sites are characterized by moderately deep to deep soils that are well drained with moderately slow to moderate permeability and medium runoff potential (Table E-3; NRCS 2020a). Topsoil textures are characterized by loam to fine sandy loam and average depth is approximately 13.40 ± 4.59 inches. Subsoil textures are characterized by loam to gravelly clay loam. Subsoil texture is clayey. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table E-3).

TABLE E-3 SOIL CHARACTERISTICS TYPICAL OF HIGH MOUNTAIN LOAM (ASPEN) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Colluvium and alluvium derived from sandstone, limestone, and shale sedimentary rock
Topsoil depth	13.40 ± 4.59 inches
Topsoil texture	Loam to fine sandy loam
Topsoil fragments	5%–10% gravel, 2%–70% cobble
Topsoil pH	5.6–7.0
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–5
Subsoil texture	Loam to gravelly clay loam
Subsoil fragments	7%–80% gravel, 3%–50% cobble
Subsoil pH	5.3–7.2
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0–5

Sources: NRCS (2020a, 2020d)

2.1.2 Vegetation

Vegetative composition by growth forms in High Mountain Loam (Aspen) ecological sites is approximately 25% grasses, 10% forbs, 10% shrubs, and 55% mature aspen (Table E-4; NRCS 2020a). The dominant grasses that may occur in High mountain Loam (Aspen) ecological sites include California brome, Ross' sedge (*Carex rossii*), and blue wildrye (NRCS 2020a). Other grasses and grass-like plants may include Letterman's needlegrass, Columbia needlegrass, fringed brome (*Bromus ciliatus*), spreading wheatgrass (*Elymus scribneri*), Idaho fescue, oniongrass, alpine timothy (*Phleum alpinum*), Wheeler bluegrass (*Poa nervosa*), nodding bluegrass (*Poa reflexa*), spike trisetum (*Trisetum spicatum*), sheep fescue. Alderleaf mountain mahogany is the dominant woody plant. Other woody plants that may occur include common juniper (*Juniperus communis*) and mountain snowberry.

TABLE E-4 VEGETATION CHARACTERISTICS TYPICAL OF HIGH MOUNTAIN LOAM (ASPEN) ECOLOGICAL SITES

Growth Form	Composition	Cover
Grasses	25%	10%–15%
Forbs	10%	5%–10%
Shrubs	10%	5%–10%
Aspen	55%	10%–15%

Source: NRCS (2020a)

2.2 High Mountain Stony Loam (Conifer) Ecological Site Description

High Mountain Stony Loam (Conifer) ecological sites in the TWE Project within the MLSNF and UWCNF occur on mountain slopes and ridges on all aspects and slopes ranging from 8% to 60% (NRCS 2020a). Major soil series associated with High Mountain Stony Loam (Conifer/Mixed Conifer) ecological sites include Agassiz, Skutum, and Lizzant. The climate in High Mountain Stony Loam (Conifer) ecological sites is characterized by cold, long, snowy winters and cool, dry summers. The annual precipitation ranges from 25 to 35 inches with most of the precipitation falling as winter snow or spring rain (NRC 2011). Available soil moisture for plant growth decreases with increasing ambient temperatures in June, July, and August (NRCS 2020a).

2.2.1 Soil Characteristics

High Mountain Stony Loam (Conifer) ecological sites are characterized by moderately deep to deep soils that are well drained with moderately slow to moderate permeability and medium to high runoff potential (Table E-5; NRCS 2020a). Topsoil textures range from fine sandy loam to very cobbly loam and average depth is approximately 10.00 ± 3.06 inches. Subsoil textures are characterized by very cobbly loam to very cobbly silty clay loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table E-5).

TABLE E-5 SOIL CHARACTERISTICS TYPICAL OF HIGH MOUNTAIN STONY LOAM (CONIFER) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium, colluvium, and residuum derived from limestone and shale sedimentary rock
Topsoil depth	10.00 ± 3.06 inches
Topsoil texture	Fine sandy loam to very cobbly loam
Topsoil fragments	35%–70% gravel, 0%–10% cobble
Topsoil pH	7.0–8.4
Topsoil salinity (EC)	0 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Very cobbly loam to very cobbly silty clay loam
Subsoil fragments	40% gravel, 15%cobble
Subsoil pH	6.5–8.8
Subsoil salinity (EC)	0 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.2.2 Vegetation

Vegetative composition by growth forms in High Mountain Stony Loam (Conifer) ecological sites is approximately 45% grasses, 10% forbs, 35% shrubs, and 10% conifers (Table E-6; NRCS 2020a). The dominant grasses that may occur in High Mountain Stony Loam (Conifer/Mixed Conifer) ecological sites include Geyer's sedge and slender wheatgrass (NRCS 2020a). Overstory conifers include subalpine fir, Douglas-fir (*Pseudotsuga menziesii*), and white fir.

TABLE E-6 VEGETATION CHARACTERISTICS TYPICAL OF HIGH MOUNTAIN STONY LOAM (CONIFER) ECOLOGICAL SITES

Growth Form	Composition
Grasses	45%
Forbs	10%
Shrubs	35%
Conifers	10%

Source: NRCS (2020a)

2.3 Mountain Loam (Mountain Big Sagebrush) Ecological Site Description

Mountain Loam (Mountain Big Sagebrush) ecological sites in the TWE Project within the MLSNF and UWCNF occur on mountain slopes, hills, swales, stream terraces, and terminal moraines on all aspects and on slopes ranging from 25% to 70% (NRCS 2020a). Major soil series associated with Mountain Loam (Mountain Big Sagebrush) ecological sites include Ant Flat and Obrast. The climate in Mountain Loam (Mountain Big Sagebrush) ecological sites is characterized by cold snowy winters and cool dry summers. Winter and spring precipitation, as snow and rainfall respectively, are the most reliable sources of available moisture to support vegetation growth. In Mountain Loam (Mountain Big Sagebrush) ecological sites, limited available moisture during July and August is associated with high rates of evapotranspiration, which slows down vegetative growth (NRCS 2020a).

2.3.1 Soil Characteristics

Mountain Loam (Mountain Big Sagebrush) ecological sites are characterized by moderately deep to deep soils that are well drained to somewhat excessively drained with moderately slow to moderate permeability and medium runoff potential (Table E-7; NRCS 2020a). Topsoil textures range from loam to silty loam and depth averages approximately 4.5 ± 5.0 inches. Soil pH ($\text{pH} > 8.4$), salinity (electrical conductivity [EC] > 4.0 deciSiemens per meter [dS/m]), and sodicity (sodium adsorption ratio [SAR] > 12.0) may limit vegetation growth in some areas (see Table E-7).

TABLE E-7 SOIL CHARACTERISTICS TYPICAL OF MOUNTAIN LOAM (MOUNTAIN BIG SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium, residuum, and colluvium from sandstone and shale sedimentary rock
Topsoil depth	4.5 ± 5.0 inches
Topsoil texture	Loam to silty loam
Topsoil fragments	5%–15% rock fragments
Topsoil pH	7.0
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Clay to silty clay loam
Subsoil fragments	0%–30% cobbles and shale
Subsoil pH	7.0–8.4
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.3.2 Vegetation

Vegetative composition in Mountain Loam (Mountain Big Sagebrush) ecological sites by growth forms is 55% grasses or grass-like plants, 20% forbs, and 25% woody plants (Table E-8; NRCS 2020a). The major grasses include bluebunch wheatgrass, and basin wildrye (*Leymus cinereus*). Other grasses and grass-like plants may include Indian ricegrass, Letterman's needlegrass (*Achnatherum lettermanii*), slender wheatgrass (*Elymus trachycaulus*), needle and thread, and western wheatgrass. Mountain big sagebrush is the major woody plant. Other woody plants that may occur include yellow rabbitbrush (*Chrysothamnus viscidiflorus*), antelope bitterbrush, Saskatoon serviceberry (*Amelanchier alnifolia*), and broom snakeweed.

TABLE E-8 VEGETATION CHARACTERISTICS TYPICAL OF MOUNTAIN LOAM (MOUNTAIN BIG SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition	Cover
Grasses	55%	44%–46%
Forbs	20%	9%–11%
Shrubs	25%	14%–16%

Source: NRCS (2020a)

2.4 Mountain Shallow Loam (Mountain Big Sagebrush) Ecological Site Description

Mountain Shallow Loam (Mountain Big Sagebrush) ecological sites in the TWE Project within the MLSNF and UWCNF occur almost exclusively on mountainsides within gentle to very steep slopes, but Mountain Shallow Loam (Mountain Big Sagebrush) can also occur on ridge tops and hills on relatively dry, south- and west-facing exposures (NRCS 2020a). Major soil series associated with Mountain Shallow Loam (Mountain Big Sagebrush) ecological sites include Agassiz, Bagard, and Wallsburg. The climate in Mountain Shallow Loam (Mountain Big Sagebrush) is characterized by cold snowy winters and cool dry summers. The average annual precipitation ranges from 19 to 27 inches and 60% of the moisture falls between October and March. In Mountain Shallow Loam (Mountain Big Sagebrush) ecological sites, limited precipitation during June and September is associated with high rates of evapotranspiration (NRCS 2020a).

2.4.1 Soil Characteristics

Mountain Shallow Loam (Mountain Big Sagebrush) ecological sites are characterized by moderately shallow soils that are well drained with moderately slow to slow permeability and medium runoff potential (Table E-9; NRCS 2020a). Topsoil textures range from very cobbly silt loams to extremely cobbly very fine sandy loam and depth averages approximately 5.30 ± 3.33 inches. Subsoil textures are characterized by very cobbly silt clay loam to very cobbly clay loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table E-9).

TABLE E-9 SOIL CHARACTERISTICS TYPICAL OF MOUNTAIN SHALLOW LOAM (MOUNTAIN BIG SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium and colluvium from sandstone and shale sedimentary rock
Topsoil depth	5.30 ± 3.33 inches
Topsoil texture	Very cobbly silt loams to extremely cobbly very fine sandy loams

Soil Characteristics	Description
Topsoil fragments	40%–60% cobbles and stones
Topsoil pH	6.6–7.1
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Very cobbly silt clay loam to very cobbly clay loam
Subsoil fragments	35%–60% cobbles and stones
Subsoil pH	6.0–7.2
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.4.2 Vegetation

Vegetative structure (% cover) in Mountain Shallow Loam (Mountain Big Sagebrush) ecological sites is dominated by grasses (Table E-10; NRCS 2020a). The dominant grasses that may occur in Mountain Shallow Loam (Mountain Big Sagebrush) ecological sites include bluebunch wheatgrass, muttongrass (*Poa fendleriana*), Columbia needlegrass, squirreltail, and western wheatgrass (*Pascopyrum smithii*) (NRCS 2020a). Other grasses and grass-like plants may include Indian ricegrass, Letterman's needlegrass, Geyer's sedge, prairie Junegrass, basin wildrye, spike fescue, oniongrass, and Sandberg bluegrass. Mountain big sagebrush is the major woody plant. Other woody plants that may occur include antelope bitterbrush, and mountain snowberry.

TABLE E-10 VEGETATION CHARACTERISTICS TYPICAL OF MOUNTAIN SHALLOW LOAM (MOUNTAIN BIG SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Cover
Grasses	29%–31%
Forbs	4%–6%
Shrubs	19%–21%

Source: NRCS (2020a)

2.5 Mountain Stony Loam (Antelope Bitterbrush) Ecological Site Description

Mountain Stony Loam (Antelope Bitterbrush) ecological sites in the TWE Project within the MLSNF and UWCNF occur on mountain slopes, ridges, and alluvial fans on all aspects with slopes ranging from 20% to 70% (NRCS 2020a). Major soil series associated with Mountain Stony Loam (Antelope Bitterbrush) ecological sites include Antflat, Bagard, Lizzant, Bezzant, Clegg, and Lodar. The climate in Mountain Stony Loam (Antelope Bitterbrush) ecological sites is characterized by cold snowy winters and cool dry summers. The average annual precipitation ranges from 22 to 30 inches and 55% to 60% of the precipitation falls between October and March. In Mountain Stony Loam (Antelope Bitterbrush) ecological sites, limited available moisture during June and September is associated with high rates of evapotranspiration (NRCS 2020a).

2.5.1 Soil Characteristics

Mountain Stony Loam (Antelope Bitterbrush) ecological sites are characterized by moderately deep to deep soils that are well drained to somewhat excessively drained with moderately slow to moderate permeability and medium runoff potential (Table E-11; NRCS 2020a). Topsoil textures range from loam

to very cobbly loam and depth averages approximately 9.8 ± 2.80 inches. Subsoil textures are characterized by gravelly loam to silty loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table E-11).

TABLE E-11 SOIL CHARACTERISTICS TYPICAL OF MOUNTAIN STONY LOAM (ANTELOPE BITTERBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium, residuum, and colluvium from sandstone and shale sedimentary rock
Topsoil depth	9.8 ± 2.8 inches
Topsoil texture	Loam to very cobbly loam
Topsoil fragments	10%–35% cobbles and gravel
Topsoil pH	6.6–8.4
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Gravelly loam to silty loam
Subsoil fragments	20%–80% cobbles and gravel
Subsoil pH	6.0–9.0
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.5.2 Vegetation

Vegetative structure (% cover) in Mountain Stony Loam (Antelope Bitterbrush) ecological sites is dominated by grasses (Table E-12; NRCS 2020a). The dominant grasses that may occur in Mountain Stony Loam (Antelope Bitterbrush) ecological sites include bluebunch wheatgrass, Letterman's needlegrass, and slender wheatgrass (NRCS 2020a). Other grasses and grass-like plants may include Geyer's sedge, squirreltail, sheep fescue, needle and thread, prairie Junegrass, basin wildrye, spike fescue, oniongrass, muttongrass, and Sandberg bluegrass. Antelope bitterbrush is the major woody plant. Other woody plants that may occur include mountain big sagebrush.

TABLE E-12 VEGETATION CHARACTERISTICS TYPICAL OF MOUNTAIN STONY LOAM (ANTELOPE BITTERBRUSH) ECOLOGICAL SITES

Growth Form	Cover
Grasses	39%–41%
Forbs	4%–6%
Shrubs	19%–21%

Source: NRCS (2020a)

2.6 Mountain Stony Loam (Gambel Oak) Ecological Site Description

Mountain Stony Loam (Gambel oak) ecological sites in the TWE Project within the MLSNF and UWCNF occur on gently sloping to very steep mountain sides, alluvial fans, and fan remnants on all aspects and on slopes ranging from 15 to 70% (NRCS 2020a). The Major soil series associated with Mountain Stony Loam (Gambel oak) ecological sites is Wallsburg. The climate in Mountain Stony Loam (Gambel oak) ecological sites is characterized by cold snowy winters and cool dry summers. The average annual precipitation ranges from 16 to 23 inches and 65% of the precipitation falls between October and

March. In Mountain Stony Loam (Gambel oak) ecological sites, limited available moisture during July, August, and September is associated with high rates of evapotranspiration (NRCS 2020a).

2.6.1 Soil Characteristics

Mountain Stony Loam (Gambel oak) ecological sites are characterized by moderately deep to deep soils that are well drained with moderately slow permeability and medium runoff potential (Table E-13; NRCS 2020a). Topsoil textures are characterized by extremely cobbly very fine sand loams and depth is approximately 2.0 inches. Subsoil textures are characterized by very cobbly clay loam. Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table E-13).

TABLE E-13 SOIL CHARACTERISTICS TYPICAL OF MOUNTAIN STONY LOAM (GAMBEL OAK) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium, residuum, and colluvium from sandstone and shale sedimentary rock
Topsoil depth	2.0 inches
Topsoil texture	Extremely cobbly very fine sand loams
Topsoil fragments	65% cobbles
Topsoil pH	7.1
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Very cobble clay loam
Subsoil fragments	65% cobbles and stones
Subsoil pH	7.0–7.1
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.6.2 Vegetation

Vegetative composition by growth forms in Mountain Stony Loam (Gambel oak) ecological sites is approximately 35% grasses, 10% forbs, and 55% shrubs (Table E-14; NRCS 2020a). The dominant grasses that may occur in Mountain Stony Loam (Gambel oak) ecological sites include slender wheatgrass, bluebunch wheatgrass, and muttongrass (NRCS 2020a). Other grasses and grass-like plants may include Indian ricegrass, Columbia needlegrass, California brome, Geyer's sedge, prairie Junegrass, basin wildrye, and oniongrass. Gambel oak is the major woody plant. Other woody plants that may occur include mountain big sagebrush and antelope bitterbrush.

TABLE E-14 VEGETATION CHARACTERISTICS TYPICAL OF MOUNTAIN STONY LOAM (GAMBEL OAK) ECOLOGICAL SITES

Growth Form	Composition	Cover
Grasses	35.0%	24%–26%
Forbs	10.0%	9%–11%
Shrubs	55.0%	39%–41%

Source: NRCS (2020a)

2.7 Mountain Stony Loam (Shrub) Ecological Site Description

Mountain Stony Loam (Shrub) ecological sites in the TWE Project within the MLSNF and UWCNF occur on mountain slopes and on hills with a northern exposure on slopes ranging from 25% to 50% (NRCS 2020a). The major soil series associated with Mountain Stony Loam (Shrub) ecological sites is Flynncove. The climate in Mountain Stony Loam (Shrub) ecological sites is characterized by cold snowy winters and cool, moist summers. On average, January through April are the driest months and May through October are the wettest months (NRCS 2020a).

2.7.1 Soil Characteristics

Mountain Stony Loam (Shrub) ecological sites are characterized by moderately deep to deep soils that are well drained with moderately slow to moderate permeability and medium runoff potential (Table E-15; NRCS 2020a). Topsoil textures range from cobble loam to extremely stony loam and depth is approximately 8.0 inches. Subsoil textures are characterized by cobbly sandy clay to extremely stony sandy clay loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table E-15).

TABLE E-15 SOIL CHARACTERISTICS TYPICAL OF MOUNTAIN STONY LOAM (SHRUB) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium and colluvium from sandstone and quartzite sedimentary rock
Topsoil depth	8.0 inches
Topsoil texture	Cobble loam to extremely stony loam
Topsoil fragments	10% cobbles and 10% gravel
Topsoil pH	7.0
Topsoil salinity (EC)	0 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Cobbly sandy clay loam to extremely stony sandy clay loam
Subsoil fragments	5% stones, 10% cobbles, 30% gravel
Subsoil pH	7.0
Subsoil salinity (EC)	0 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.7.2 Vegetation

Vegetative composition by growth forms in Mountain Stony Loam (Shrub) ecological sites is approximately 30% grasses, 10% forbs, and 60% shrubs (Table E-16; NRCS 2020a). The dominant grasses that may occur in Mountain Stony Loam (Shrub) ecological sites include bluebunch wheatgrass and Geyer's sedge (NRCS 2020a). Other grasses and grass-like plants may include Indian ricegrass, Letterman's needlegrass, California brome, slender wheatgrass, needle and thread, basin wildrye, western wheatgrass, and Sandberg bluegrass. Alderleaf mountain mahogany, Utah serviceberry (*Amelanchier utahensis*), mountain big sagebrush, chokecherry (*Prunus virginiana*), and mountain snowberry are the dominant woody plants. Other woody plants that may occur include mountain big sagebrush.

TABLE E-16 VEGETATION CHARACTERISTICS TYPICAL OF MOUNTAIN STONY LOAM (SHRUB) ECOLOGICAL SITES

Growth Form	Composition	Cover
Grasses	30%	19%–21%
Forbs	10%	4%–6%
Shrubs	60%	49%–51%

Source: NRCS (2020a)

2.8 Upland Loam (Basin Big Sagebrush) Ecological Site Description

Upland Loam (Basin Big Sagebrush) ecological sites in the TWE Project within the MLSNF and UWCNF occur on mountains, alluvial fans, fan remnants, and hillslopes on south and southwest aspects, and on slopes ranging from 4% to 70% (NRCS 2020a). Major soil series associated with Upland Loam (Basin Big Sagebrush) ecological sites are Ant Flat and Sanpitch. The climate in Upland Loam (Basin Big Sagebrush) ecological sites is characterized by cold, snowy winters and dry, warm summers. On average, May is the wettest month of the year, while June, July, and August are the driest (NRCS 2020a).

2.8.1 Soil Characteristics

Upland Loam (Basin Big Sagebrush) ecological sites are characterized by moderately deep to deep soils that are well drained with moderately slow to moderate permeability and medium runoff potential (Table E-17; NRCS 2020a). Topsoil textures range from loam to very stony loam and depth is approximately 7.0 ± 0.0 inches. Subsoil textures are characterized by clay loam to gravelly clay loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table E-17).

TABLE E-17 SOIL CHARACTERISTICS TYPICAL OF UPLAND LOAM (BASIN BIG SAGEBRUSH) ECOLOGICAL SITES.

Soil Characteristics	Description
Parent material	Alluvium and colluvium from igneous, limestone, and shale sedimentary rock
Topsoil depth	7.0 ± 0.0 inches
Topsoil texture	Loam to very stony loam
Topsoil fragments	15% rocks, 25% gravel
Topsoil pH	7.0–8.2
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–1
Subsoil texture	Clay loam to gravelly clay loam
Subsoil fragments	0%–35% rock, 15%–35% gravel and cobble
Subsoil pH	7.2–8.6
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.8.2 Vegetation

Vegetative structure (% cover) by growth forms in Upland Loam (Basin Big Sagebrush) ecological sites is dominated by grasses (Table E-18; NRCS 2020a). The dominant grasses that may occur in Upland Loam (Basin Big Sagebrush) ecological sites include bluebunch wheatgrass, Indian ricegrass, needle and

thread, and basin wildrye (NRCS 2020a). Other grasses and grass-like plants may include squirreltail, prairie Junegrass, and western wheatgrass. Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) is the dominant woody plant. Other woody plants that may occur include yellow rabbitbrush, broom snakeweed, and winterfat.

TABLE E-18 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND LOAM (BASIN BIG SAGEBRUSH) ECOLOGICAL SITES.

Growth Form	Cover
Grasses	49%–51%
Forbs	9%–11%
Shrubs	24%–26%

Source: NRCS (2020a)

2.9 Upland Loam (Bonneville Big Sagebrush) North Ecological Site Description

Upland Loam (Bonneville Big Sagebrush) North ecological sites in the TWE Project within the MLSNF and UWCNF occur on lake benches and alluvial fans and fan remnants on slopes ranging from 0% to 30% (NRCS 2020a). Major soil series associated with Upland Loam (Bonneville Big Sagebrush) North ecological sites are Ant Flat and Birdow. The climate in Upland Loam (Bonneville Big Sagebrush) North ecological sites is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges between 14 and 16 inches. On average, May is typically the wettest month and July the driest (NRCS 2020a).

2.9.1 Soil Characteristics

Upland Loam (Bonneville Big Sagebrush) North ecological sites are characterized by moderately deep to deep soils that are well drained with moderately slow to moderate permeability and medium runoff potential (Table E-19; NRCS 2020a). Topsoil textures range from loam to fine sandy loam and depth is approximately 10.0 ± 6.0 inches. Subsoil textures are characterized by clay loam to sandy clay loam. Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table E-19).

TABLE E-19 SOIL CHARACTERISTICS TYPICAL OF UPLAND LOAM (BONNEVILLE BIG SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium and colluvium from igneous, limestone, and shale sedimentary rock
Topsoil depth	10.0 ± 6.00 inches
Topsoil texture	Loam to fine sandy loam
Topsoil fragments	5%–15% rock fragments
Topsoil pH	7.0–8.6
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Clay loam to sandy clay loam
Subsoil fragments	0%–35% gravel
Subsoil pH	7.2–8.6

Soil Characteristics	Description
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.9.2 Vegetation

Vegetative composition by growth forms in Upland Loam (Bonneville Big Sagebrush) North ecological sites is approximately 60% grasses, 25% forbs, and 15% shrubs (Table E-20; NRCS 2020a).

The dominant grasses that may occur in Upland Loam (Bonneville Big Sagebrush) North ecological sites include slender wheatgrass, bluebunch wheatgrass, and Indian ricegrass (NRCS 2020a). Other grasses and grass-like plants may include squirreltail, thickspike wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*), western wheatgrass, muttongrass, beardless wheatgrass, Geyer's sedge, Idaho fescue (*Festuca idahoensis*), needle and thread, prairie Junegrass, basin wildrye, oniongrass, and purple threeawn (*Aristida purpurea*). Bonneville big sagebrush (*Artemisia tridentata* ssp. *bonnevilleensis*) is the dominant woody plant. Other woody plants that may occur include mountain snowberry.

TABLE E-20 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND LOAM (BONNEVILLE BIG SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition	Cover
Grasses	60%	12%–23%
Forbs	25%	10%–15%
Shrubs	15%	1%–2%

Source: NRCS (2020a)

2.10 Upland Stony Loam (Black Sagebrush) Ecological Site Description

Upland Stony Loam (Black Sagebrush) ecological sites in the TWE Project within the MLSNF and UWCNF occur on foothills, alluvial fans, ridges, mountainsides, and cinder cones on slopes ranging from 10% to 50% (NRCS 2020a). Major soil series associated with Upland Stony Loam (Black Sagebrush) ecological sites include Ant Flat, Bagard, Deer Creek, and Lonjon. The climate in Upland Stony Loam (Black Sagebrush) ecological sites is characterized by cold, snowy winters and cool, dry summers. The average annual precipitation ranges between 12 and 17 inches with most of the moisture falling in the spring, winter, and fall. On average, June, July, and August are the driest month of a hydrological year (NRCS 2020a).

2.10.1 Soil Characteristics

Upland Stony Loam (Black Sagebrush) ecological sites are characterized by moderately deep to deep soils that are well drained with moderately slow to moderate permeability and medium runoff potential (Table E-21; NRCS 2020a). Topsoil textures range from loam to gravelly loam and average depth is approximately 8.5 ± 1.7 inches. Subsoil textures are characterized by gravelly clay loam to gravelly silt loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table E-21).

TABLE E-21 SOIL CHARACTERISTICS TYPICAL OF UPLAND STONY LOAM (BLACK SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium, residuum, and colluvium from limestone and shale sedimentary rock
Topsoil depth	8.5 ±1.7 inches
Topsoil texture	Loam to gravelly loam
Topsoil fragments	0%–50% gravel, 0%–15% cobble
Topsoil pH	6.6–7.0
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–1
Subsoil texture	Gravelly clay loam to gravelly silt loam
Subsoil fragments	20%–35% gravel, 0%–15%cobble
Subsoil pH	6.0–8.4
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0–1

Sources: NRCS (2020a, 2020d)

2.10.2 Vegetation

Vegetative structure (% cover) in Upland Stony Loam (Black Sagebrush) ecological sites is dominated by shrubs (Table E-22; NRCS 2020a). Black sagebrush is the dominant woody plant. Other woody plants that may occur include yellow rabbitbrush, antelope bitterbrush, and Saskatoon serviceberry.

The dominant grasses that may occur in Upland Stony Loam (Black Sagebrush) ecological sites include bluebunch wheatgrass, Sandberg bluegrass, western wheatgrass, and squirreltail (NRCS 2020a). Other grasses and grass-like plants may include Indian ricegrass, Letterman's needlegrass, needle and thread, prairie Junegrass, and muttongrass.

TABLE E-22 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND STONY LOAM (BLACK SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Cover
Grasses	14%–16%
Forbs	4%–6%
Shrubs	29%–31%

Source: NRCS (2020a)

2.11 Upland Shallow Hardpan (Pinyon–Utah Juniper) Ecological Site Description

Upland Shallow Hardpan (Pinyon–Utah Juniper) ecological sites in the TWE Project within the MLSNF and UWCNF occur most commonly on alluvial fans and fan remnants, and occasionally on mountain slopes. Slopes are gentle ranging from 2% to 25%. (NRCS 2020a). The soils on this site were formed in alluvium derived mainly from limestone, sandstone, or igneous parent materials. The soil series within this ecological site in the TWE Project boundary include Ant Flat, Borvant, and Sheep Creek. The climate is cold and snowy in the winter and warm and dry in the summer. Precipitation in Upland Shallow Hardpan (Pinyon–Utah Juniper) ecological sites averages between 13 to 18 inches annually but in a few instances is as high as 20 inches on south and west exposures (NRCS 2020a).

2.11.1 Soil Characteristics

Upland Shallow Hardpan (Pinyon–Utah Juniper) ecological sites are shallow and well drained. The permeability of these soils is moderate. Runoff potential ranges from medium to high (Table E-23; NRCS 2020a). Topsoil textures include gravelly loam and cobbly loam. Topsoil depth ranges from approximately 0.0 to 3.0 inches. Subsoil textures are characterized as loamy (NRCS 2020a). Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table E-23).

TABLE E-23 SOIL CHARACTERISTICS TYPICAL OF UPLAND SHALLOW HARDPAN (PINYON–UTAH JUNIPER) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium derived mainly from limestone, sandstone, or igneous parent materials
Topsoil depth	0.0–3.0 inches
Topsoil texture	Gravelly loam and cobbly loam
Topsoil fragments	7%–13%
Topsoil pH	7.9–9.0
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Loamy
Subsoil fragments	3%–13%
Subsoil pH	7.9–9.0
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.11.2 Vegetation

Potential vegetation growth form composition in Upland Shallow Hardpan (Pinyon–Utah Juniper) ecological sites is 40% grasses or grass-like plants, 10% forbs, and 50% woody plants (Table E-24; NRCS 2020a). The major grasses found at this site include Indian ricegrass, bluebunch wheatgrass, squirreltail, and needle and thread. Other grasses and grass-like plants found at this site include prairie Junegrass, western wheatgrass, Sandberg bluegrass, and sand dropseed. Dominant woody species found at this ecological site include singleleaf pinyon, Utah juniper, black sagebrush, Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), Mexican cliffrose (*Purshia mexicana*), and antelope bitterbrush. Subdominant woody species include yellow rabbitbrush, Nevada jointfir (*Ephedra nevadensis*), broom snakeweed, stemless mock goldenweed (*Stenotus acaulis*), mountain snowberry, and shadscale saltbush (NRCS 2020a).

TABLE E-24 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND SHALLOW HARDPAN (PINYON–UTAH JUNIPER) ECOLOGICAL SITES

Growth Form	Composition
Grasses	40%
Forbs	10%
Shrubs	50%

Source: NRCS (2020a)

2.12 Upland Shallow Loam (Two-Needle Pinyon/Utah Juniper) Ecological Site Description

Upland Shallow Loam (Two-Needle Pinyon/Utah Juniper) ecological sites in the TWE Project within the MLSNF and UWCNF occur on lake terraces, escarpments, and mountain slopes ranging from 20% to 70% (NRCS 2020a). Major soil series associated with Upland Shallow Loam (Two-Needle Pinyon/Utah Juniper) ecological sites include Lodar, Bagard, Ant Flat, and Pass Canyon. The climate in Upland Shallow Loam (Two-Needle Pinyon/Utah Juniper) ecological sites is characterized by cold snowy winters and warm dry summers. The average annual precipitation ranges from 11 to 16 inches. On average, March and April are the wettest months and July, July, and September are the driest months during a normal hydrological year (NRCS 2020a).

2.12.1 Soil Characteristics

Upland Shallow Loam (Two-Needle Pinyon/Utah Juniper) ecological sites are characterized by shallow soils that are well drained with moderately slow to moderate permeability and medium to high runoff potential (Table E-25; NRCS 2020a). Topsoil textures range from very cobbly loam to very cobbly coarse sandy loam and average depth is approximately 6.20 ± 2.22 inches. Subsoil textures are characterized by very gravelly loam to sandy clay loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table E-25).

TABLE E-25 SOIL CHARACTERISTICS TYPICAL OF UPLAND SHALLOW LOAM (TWO-NEEDLE PINYON/UTAH JUNIPER) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium, residuum, and colluvium derived from sedimentary (sandstone and shale) and igneous rocks
Topsoil depth	6.20 ± 2.22 inches
Topsoil texture	Very cobbly loam to very cobbly coarse sandy loam
Topsoil fragments	10% gravel and 50% cobbles
Topsoil pH	6.6–7.8
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Very gravelly loam to sandy clay loam
Subsoil fragments	20%–80% gravel and 15% cobbles
Subsoil pH	6.0–8.4
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.12.2 Vegetation

Vegetative composition by growth forms in Upland Shallow Loam (Two-Needle Pinyon/Utah Juniper) ecological sites is approximately 50% grasses, 5% forbs, 30% shrubs, and 15% trees (Table E-26; NRCS 2020a). The dominant grasses that may occur in Upland Shallow Loam (Two-Needle Pinyon/Utah Juniper) ecological sites include Indian ricegrass, bluebunch wheatgrass, and squirreltail (NRCS 2020a). Other grasses and grass-like plants may include blue grama (*Bouteloua gracilis*), Geyer's sedge, squirreltail, needle and thread, prairie Junegrass, Salina wildrye (*Leymus salinus*), western wheatgrass, James' galleta (*Pleuraphis jamesii*), muttongrass, Sandberg bluegrass, and sand dropseed (*Sporobolus cryptandrus*). Black sagebrush is the major woody plant. Other woody plants that may occur include

alderleaf mountain mahogany, antelope bitterbrush, Utah juniper, twoneedle pinyon (*Pinus edulis*), and singleleaf pinyon.

TABLE E-26 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND SHALLOW LOAM (TWO-NEEDLE PINYON / UTAH JUNIPER) ECOLOGICAL SITES

Growth Form	Composition	Cover
Grasses	50%	25%–35%
Forbs	5%	0%–10%
Shrubs	30%	35%–45%
Trees	15%	15%–25%

Source: NRCS (2020a)

2.13 Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) Ecological Site Description

Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) ecological sites in the TWE Project within the MLSNF and UWCNF occur on mountain slopes, lake terraces, and escarpments. The site is found on slopes ranging from 20% to 70%, occurs on all aspects, and produces medium to high amounts of runoff (NRCS 2020a). The soils on this site were formed in colluvium and residuum derived mainly from limestone and chert parent materials. The soil series within this ecological site in the TWE Project boundary include Deer Creek and Obrast soil series. Precipitation in Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) ecological sites averages between 11 to 16 inches annually (NRCS 2020a).

2.13.1 Soil Characteristics

Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) ecological sites are shallow with bedrock typically within 20 inches of the soil surface. Soils are moderately slow to moderately rapidly permeable and are well drained to somewhat excessively drained (Table E-27; NRCS 2020a). Topsoil textures include extremely cobbly loam, very gravelly silt loam, and very gravelly loam. Topsoil depth ranges from approximately 9.8 to 20.0 inches. Subsoil textures are characterized as loamy (NRCS 2020a). Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table E-27).

TABLE E-27 SOIL CHARACTERISTICS TYPICAL UPLAND SHALLOW LOAM (UTAH JUNIPER–SINGLELEAF PINYON) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in colluvium and residuum derived mainly from limestone and chert parent materials
Topsoil depth	10.0–20.0 inches
Topsoil texture	Extremely cobbly loam, very gravelly silt loam, and very gravelly loam
Topsoil fragments	0%–45%
Topsoil pH	6.6–9.0
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Loam
Subsoil fragments	6%–32%
Subsoil pH	6.6–9.0

Soil Characteristics	Description
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.13.2 Vegetation

Potential vegetation growth form composition in Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) ecological sites is 40% grasses or grass-like plants, 10% forbs, and 50% woody plants (Table E-28; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass, Indian ricegrass, and squirreltail. Other commonly occurring grasses include blue grama, Geyer's sedge, squirreltail, needle and thread, prairie Junegrass, Salina wildrye, western wheatgrass, James' galleta, muttongrass, Sandberg bluegrass, and sand dropseed. Dominant woody species found at this ecological site include Utah juniper, twoneedle pinyon, singleleaf pinyon, black sagebrush, alderleaf mountain mahogany, and antelope bitterbrush. Subdominant woody species include Utah serviceberry, desert ceanothus (*Ceanothus greggii*), littleleaf mountain mahogany (*Cercocarpus intricatus*), curl-leaf mountain mahogany, yellow rabbitbrush, Nevada jointfir, slender buckwheat, broom snakeweed, plains pricklypear, Mexican cliffrose, and mountain snowberry (NRCS 2020a).

TABLE E-28 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND SHALLOW LOAM (UTAH JUNIPER–SINGLELEAF PINYON) SITES

Growth Form	Composition
Grasses	40%
Forbs	10%
Shrubs	50%

Source: NRCS (2020a)

2.14 Upland Stony Loam (Pinyon–Utah Juniper) Ecological Site Description

Upland Stony Loam (Pinyon–Utah Juniper) ecological sites in the TWE Project within the MLSNF and UWCNF are found on many landforms with deep stony soils, including mountain slopes, slump blocks, structural benches, remnant alluvial fans, remnant stream terraces, landslides, and benches. Slopes typically range between 2% and 50%. (NRCS 2020a). The soils on this site were formed in alluvium or colluvium derived from diorite or sedimentary rock, including sandstone, siltstone, limestone, and shale. The soil series within this ecological site in the TWE Project boundary include Deer Creek soil series. The climate is cold and snowy in the winter and warm and dry in the summer. Precipitation in Upland Stony Loam (Pinyon–Utah Juniper) ecological sites averages between 12 to 16 inches annually (NRCS 2020a).

2.14.1 Soil Characteristics

Upland Stony Loam (Pinyon–Utah Juniper) ecological sites are deep and well drained. The permeability of these soils is moderate (Table E-29; NRCS 2020a). Topsoil textures include cobbly very fine sandy loam, very stony sandy loam, and very stony sandy loam. Topsoil depth ranges from approximately 0.0 to 8.0 inches. Subsoil textures are characterized as loamy (NRCS 2020a). Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table E-29).

TABLE E-29 SOIL CHARACTERISTICS TYPICAL UPLAND STONY LOAM (PINYON-UTAH JUNIPER) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium or colluvium derived from diorite or sedimentary rock, including sandstone, siltstone, limestone, and shale
Topsoil depth	0.0–8.0 inches
Topsoil texture	Cobbly very fine sandy loam, very stony sandy loam, and very stony sandy loam
Topsoil fragments	14%–47%
Topsoil pH	7.4–8.4
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Loamy
Subsoil fragments	5%–29%
Subsoil pH	7.4–8.4
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.14.2 Vegetation

Potential vegetation growth form composition in Upland Stony Loam (Pinyon–Utah Juniper) ecological sites is 20% grasses or grass-like plants, 5% forbs, and 75% woody plants (Table E-30; NRCS 2020a). The major grasses found at this site include blue grama and Indian ricegrass. Other grasses and grass-like plants found at this site include needle and thread, James' galleta, Geyer's sedge, muttongrass, Salina wildrye, prairie Junegrass, and squirreltail. Dominant woody species found at this ecological site include twoneedle pinyon and Utah juniper. Subdominant woody species include Gambel oak, Utah serviceberry, alderleaf mountain mahogany, broom snakeweed, mountain big sagebrush, greenleaf manzanita (*Arctostaphylos patula*), brittle pricklypear (*Opuntia fragilis*), mountain snowberry, roundleaf buffaloberry (*Shepherdia rotundifolia*), Spanish bayonet (*Yucca harrimaniae*), plains pricklypear, wild crab apple (*Peraphyllum ramosissimum*), kingcup cactus (*Echinocereus triglochidiatus*), and mormon tea (NRCS 2020a).

TABLE E-30 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND STONY LOAM (PINYON-UTAH JUNIPER) SITES

Growth Form	Composition
Grasses	20%
Forbs	5%
Shrubs	75%

Source: NRCS (2020a)

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ATTACHMENT E-1

**U.S. Forest Service – Manti-La Sal and Uinta-Wasatch-Cache National Forests
Photographs**



Figure E-1-1 Representative High Mountain Loam (Aspen) in the USFS. Site ID 0625TD09.



Figure E-1-2 Representative High Mountain Stony Loam (Conifer/Mixed Conifer) in the USFS. Site ID 0724TD07.



Figure E-1-3 Representative Mountain Loam (Mountain Big Sagebrush) in the USFS. Site ID 0730TW06.



Figure E-1-4 Representative Mountain Loam (Oak) in the USFS. Site ID 0716RC03.



Figure E-1-5 Representative Mountain Shallow Loam (Mountain Big Sagebrush) in the USFS. Site ID 0728RD01.



Figure E-1-6 Representative High Mountain Very Steep Stony Loam (Engelmann Spruce) in the USFS. Site ID 0724RD18.



Figure E-1-7 Representative Mountain Stony Loam (Antelope Bitterbrush) in the USFS. Site ID 0716RC05.

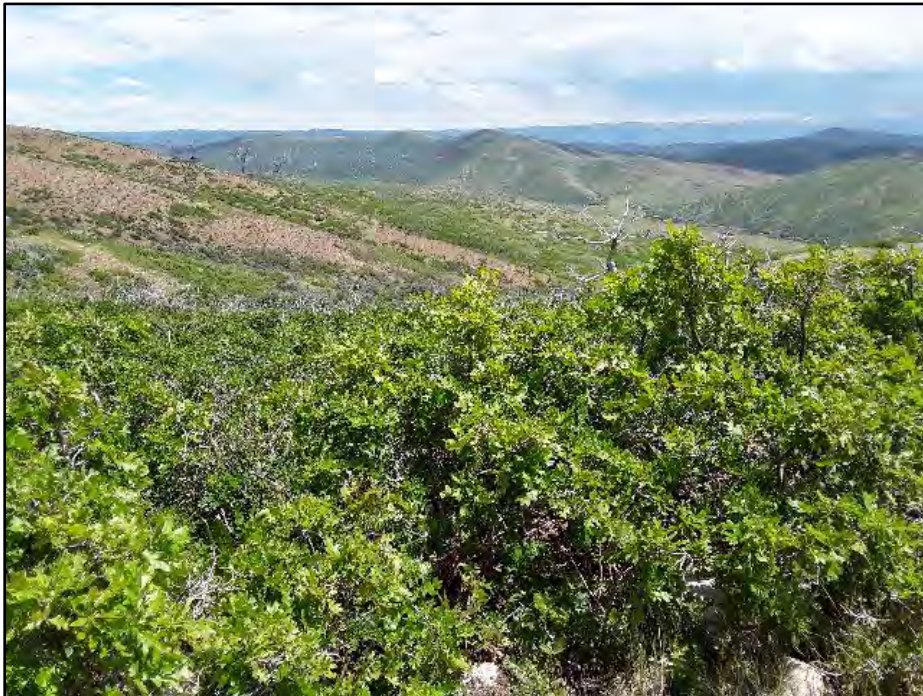


Figure E-1-8 Representative Mountain Stony Loam (Gambel Oak) in the USFS. Site ID 0711SF04.



Figure E-1-9 Representative Mountain Stony Loam (Shrub) in the USFS. Site ID 0729TW03.



Figure E-1-10 Representative Upland Loam (Basin Big Sagebrush) in the USFS. Site ID 0817CM03.



**Figure E-1-11 Representative Upland Loam (Bonneville Big Sagebrush) in the USFS.
Site ID 0711RC06.**



**Figure E-1-12 Representative Upland Shallow Hardpan (Pinyon–Utah Juniper) in the USFS.
Site ID 0805MW01.**



Figure E-1-13 Representative Upland Shallow Loam (Two-Needle Pinyon / Utah Juniper) in the USFS. Site ID 0909TA01.



Figure E-1-14 Representative Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) in the USFS. Site ID 0804MW07.



Figure E-1-15 Representative Upland Stony Loam (Pinyon-Utah Juniper) in the USFS. Site ID 0714RD03.

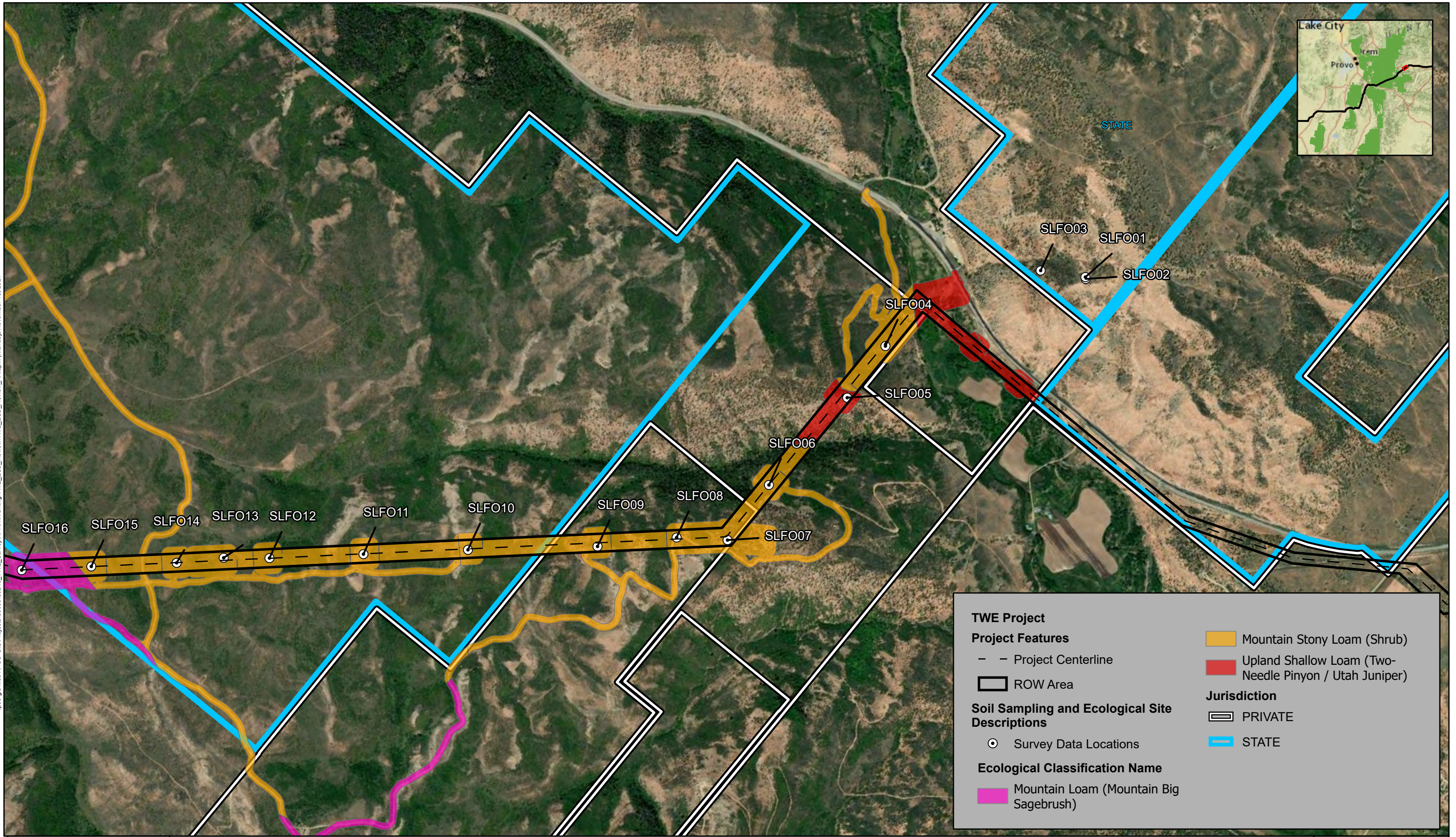


Figure E-1-16 Representative Upland Stony Loam (Black Sagebrush) in the USFS. Site ID 0817CM08.

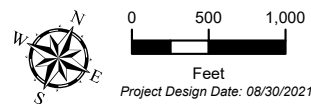
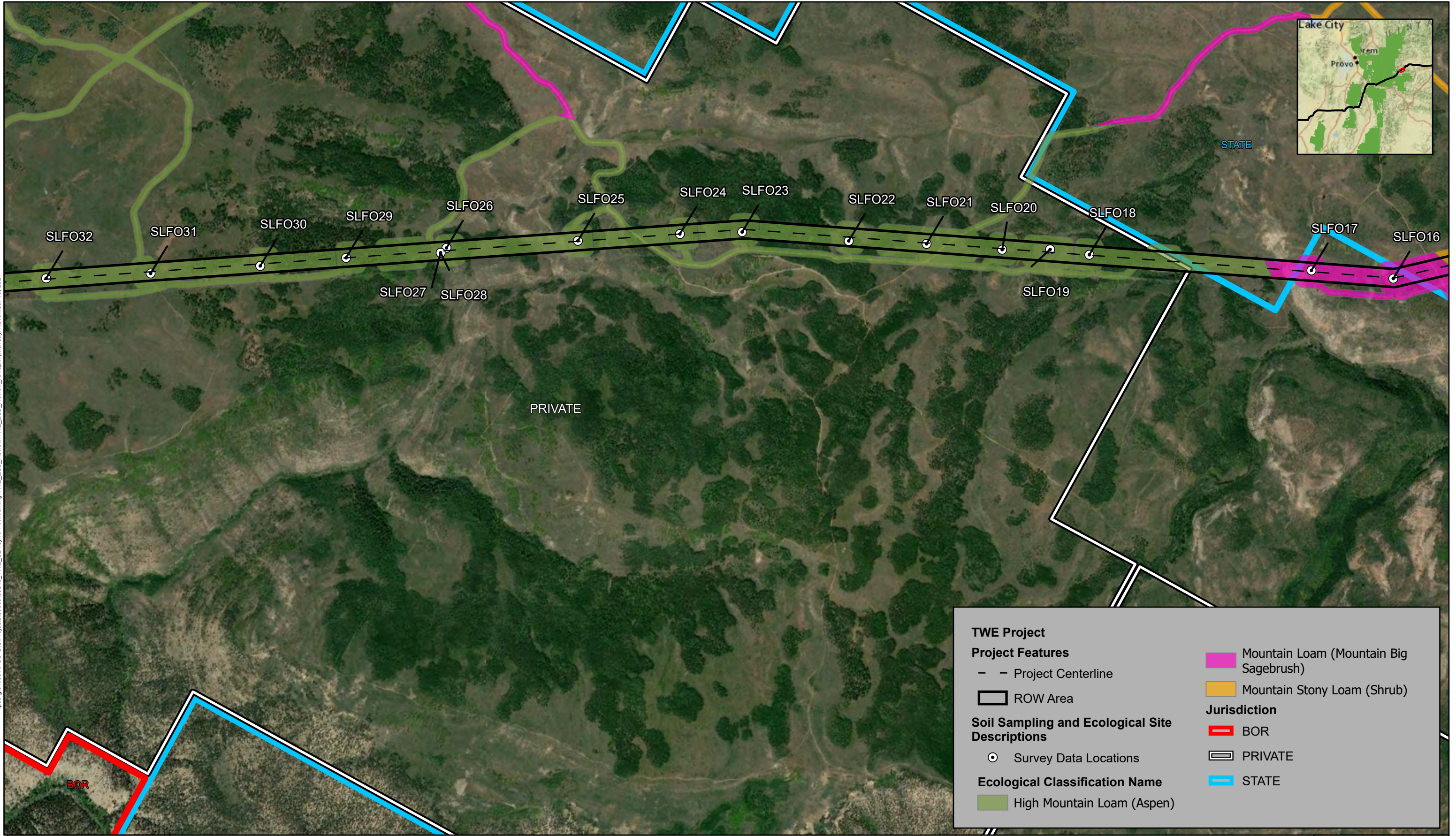
ATTACHMENT E-2

**U.S. Forest Service – Manti-La Sal and Uinta-Wasatch-Cache National Forests
Maps**

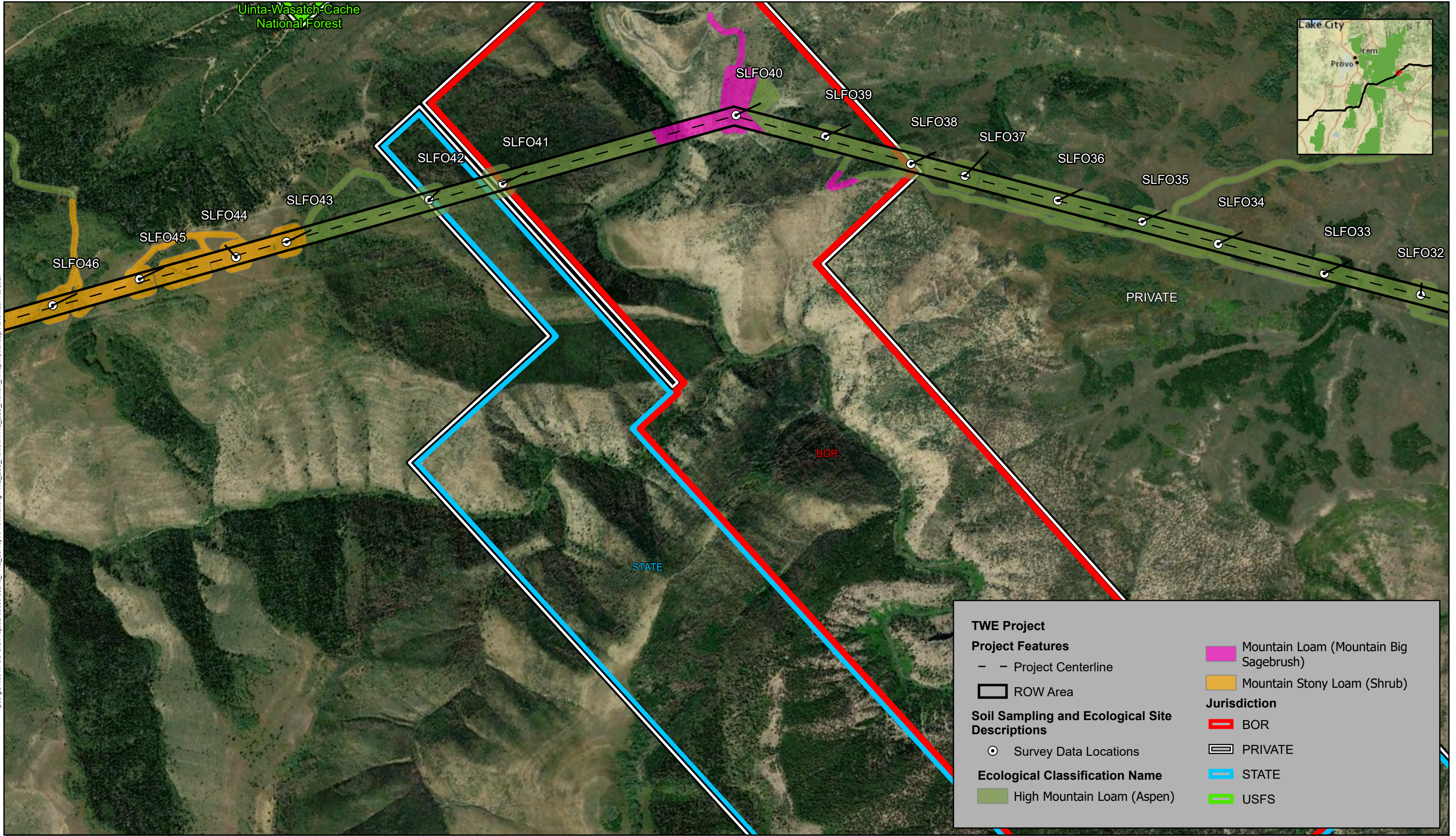
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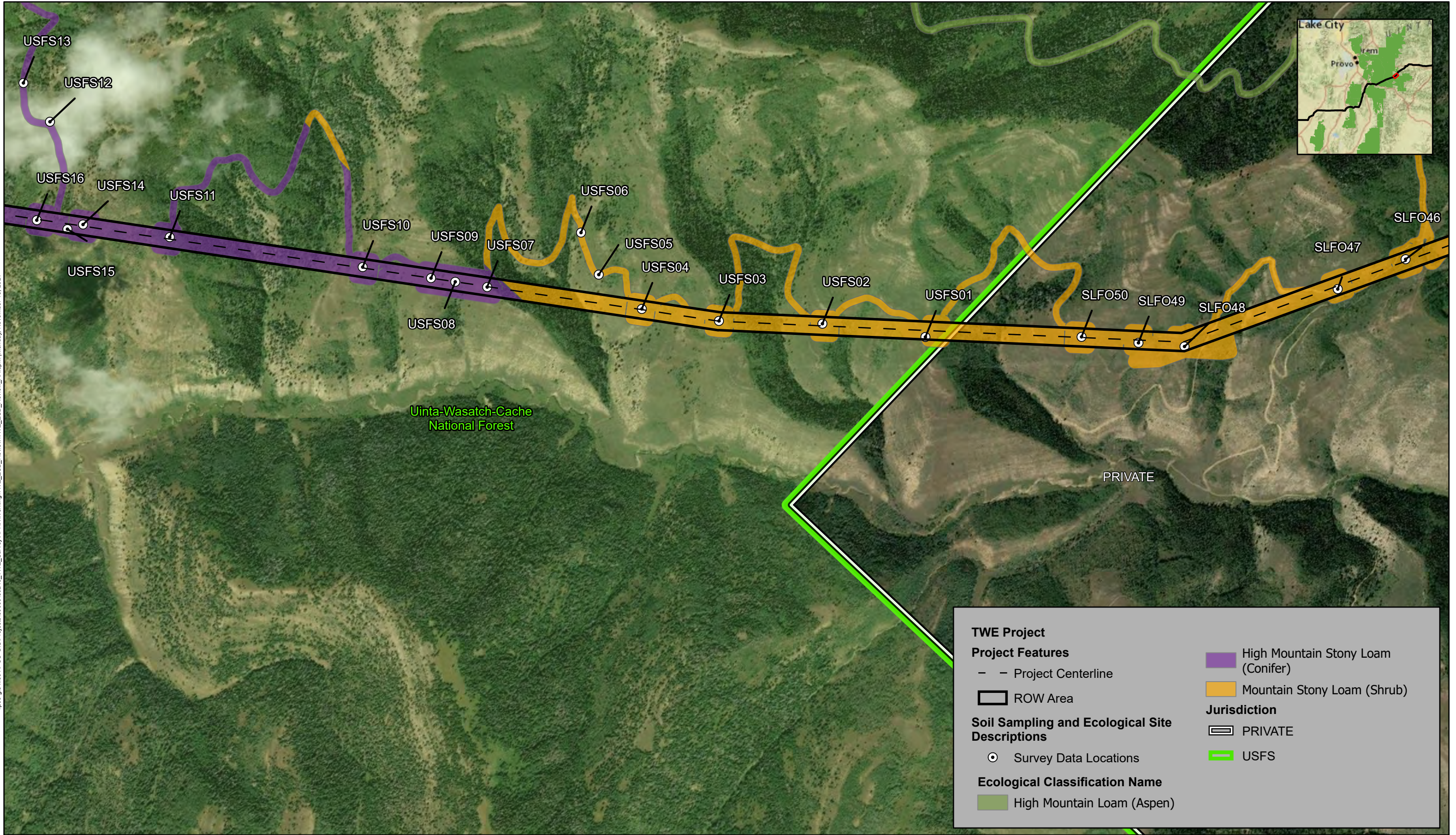
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Map 3 of 18

Ecological Site Descriptions - United States Forest Service
TransWest Express Transmission Project



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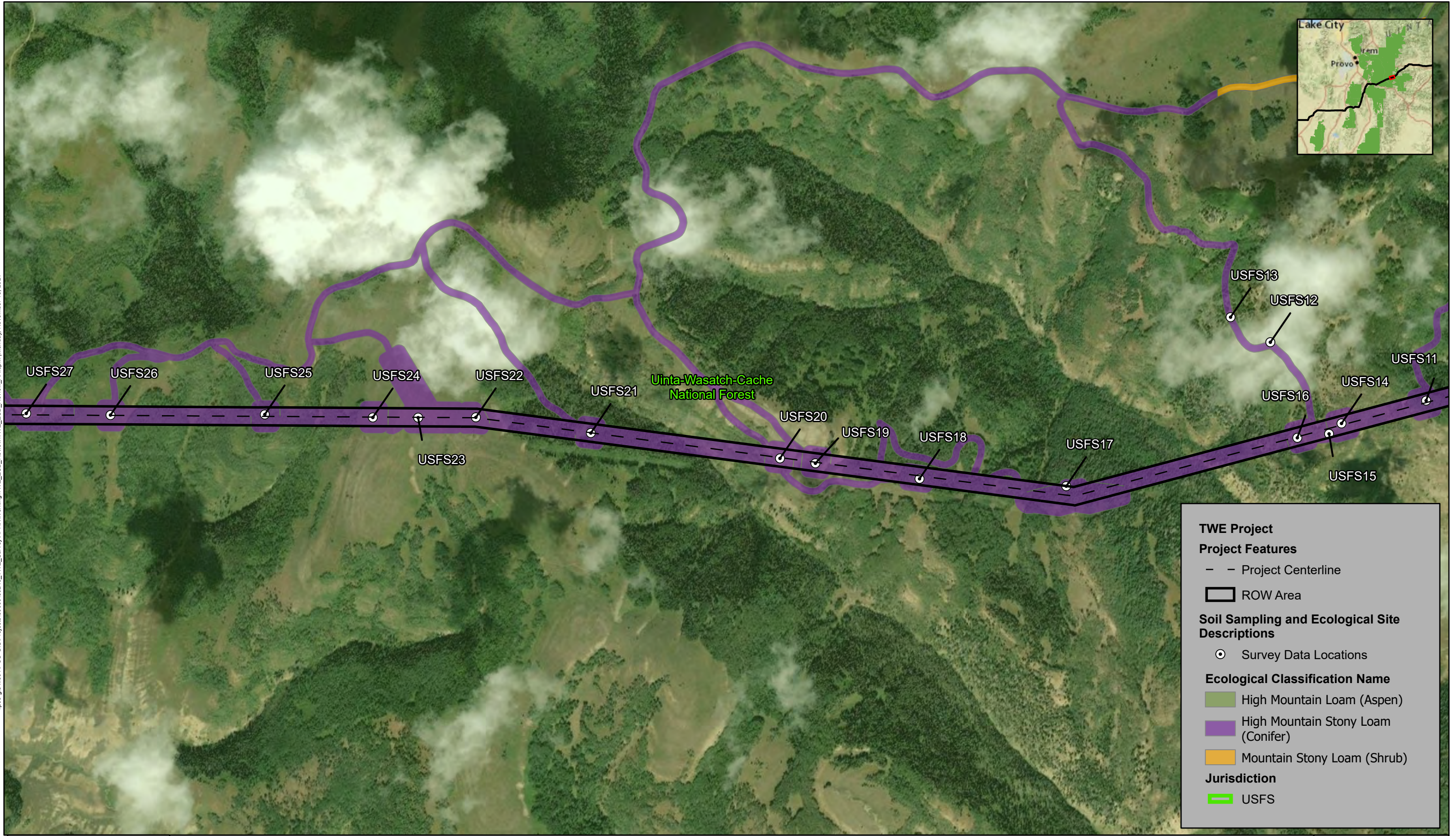
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Map 4 of 18

Ecological Site Descriptions - United States Forest Service
TransWest Express Transmission Project



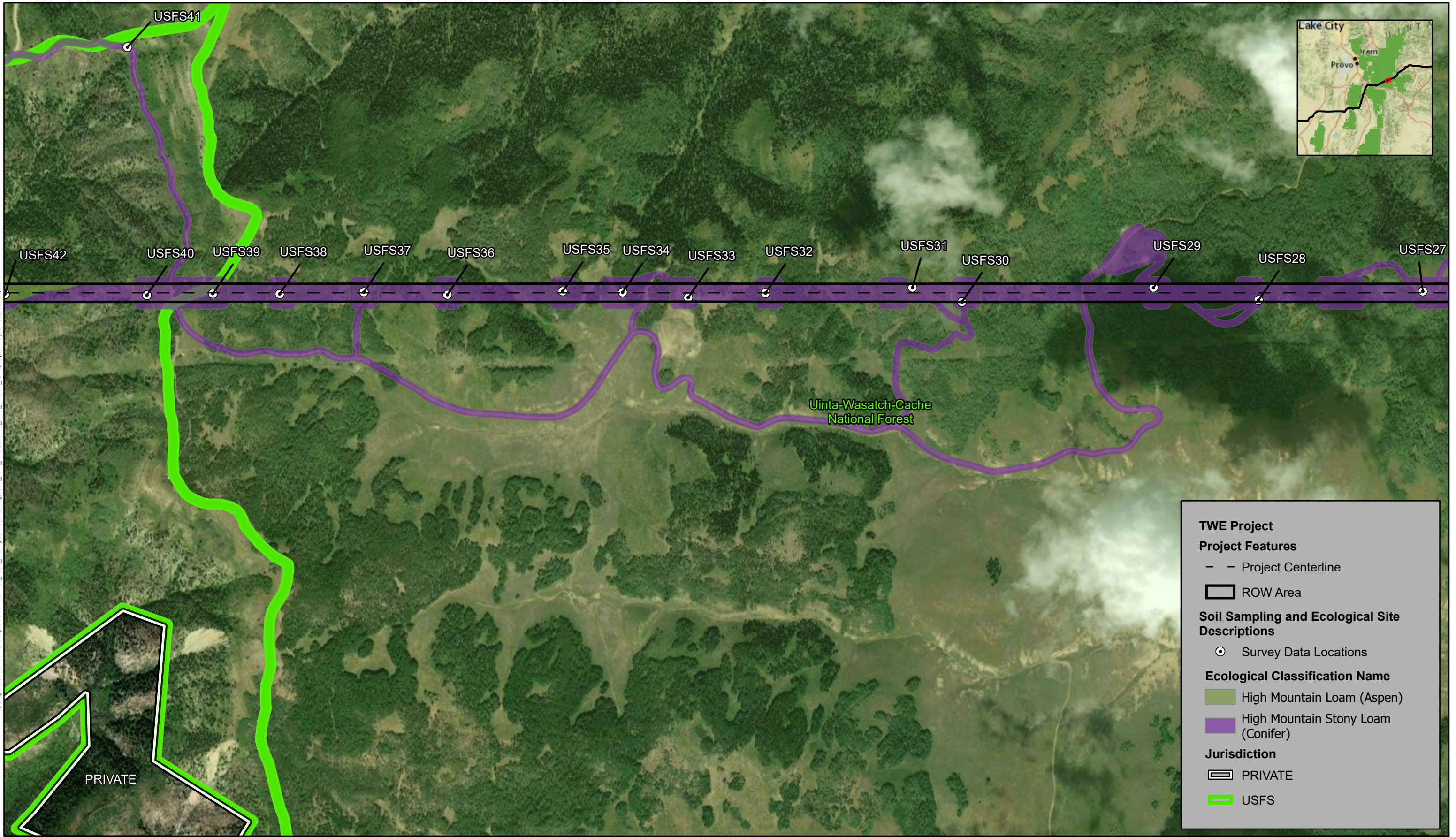
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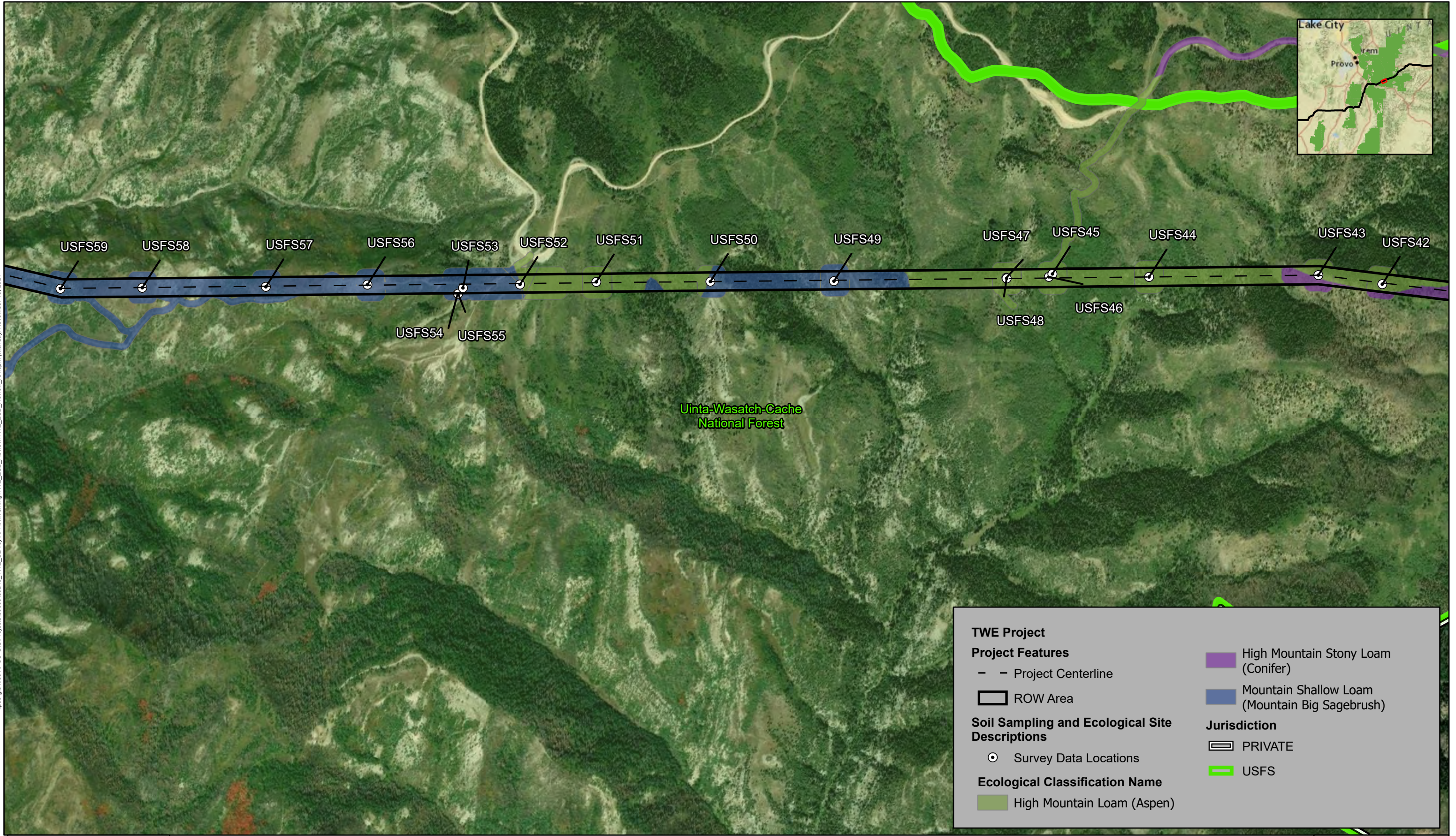
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Map 6 of 18

Ecological Site Descriptions - United States Forest Service
TransWest Express Transmission Project



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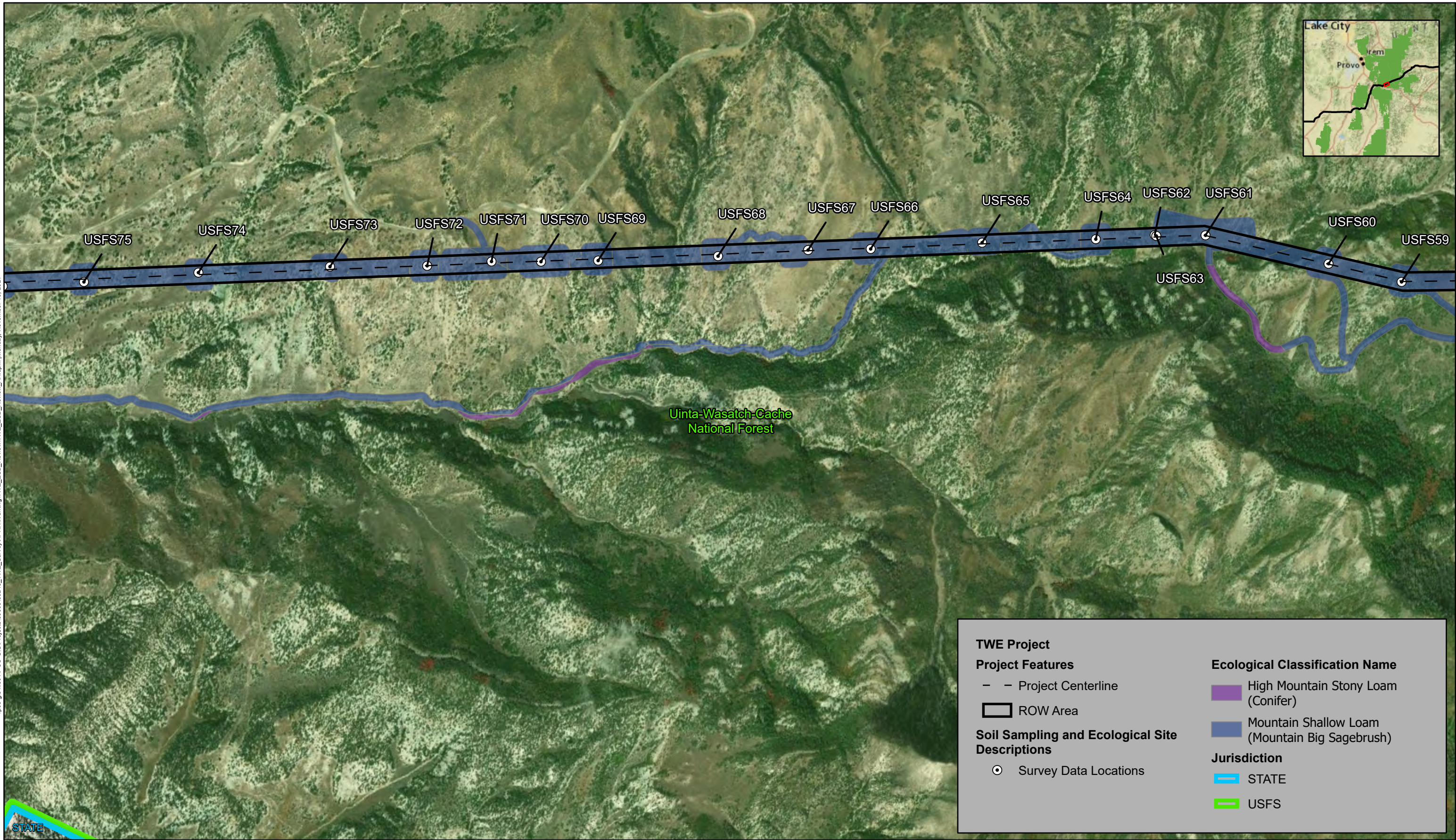
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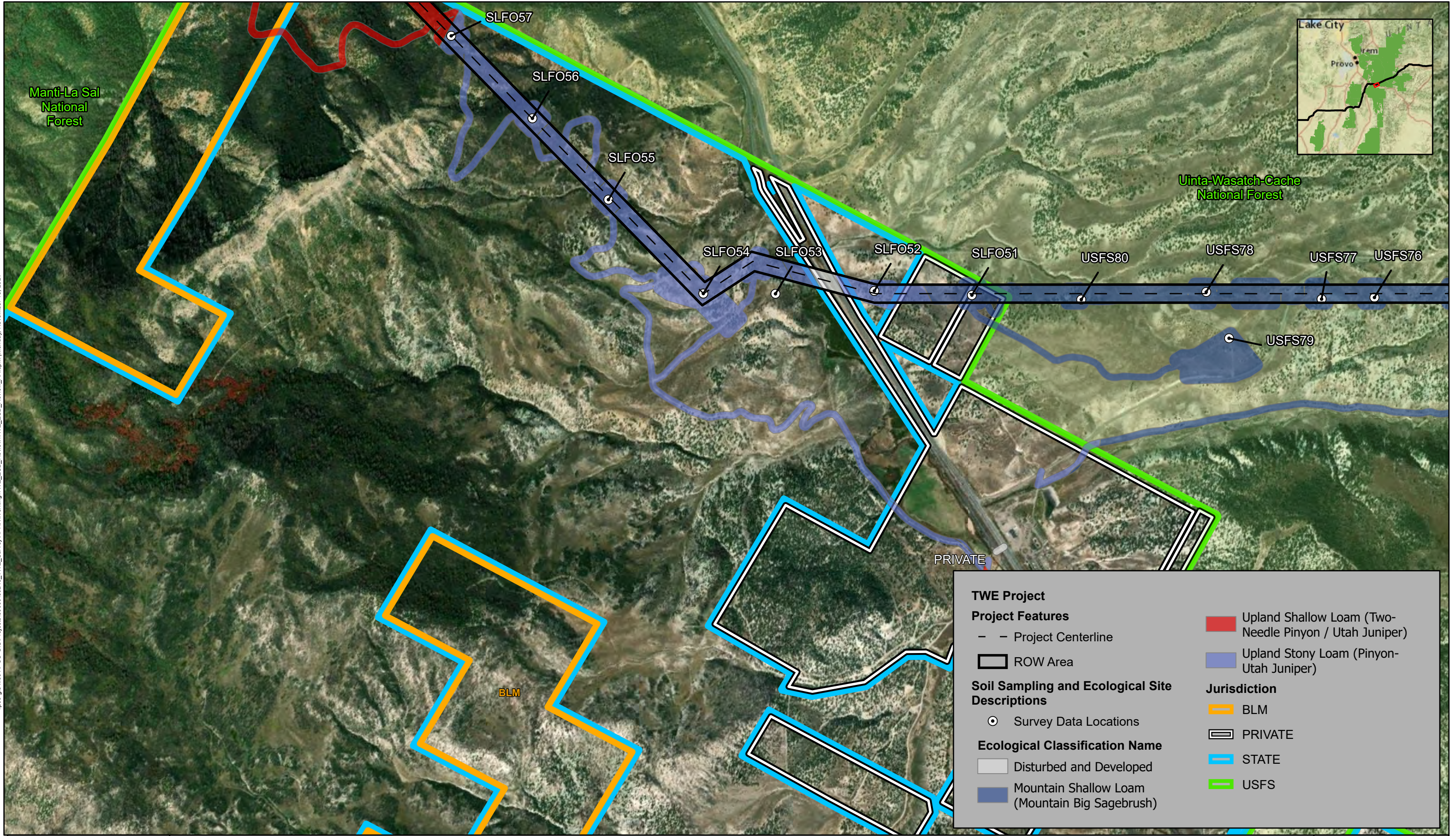
Ecological Site Descriptions - United States Forest Service
TransWest Express Transmission Project



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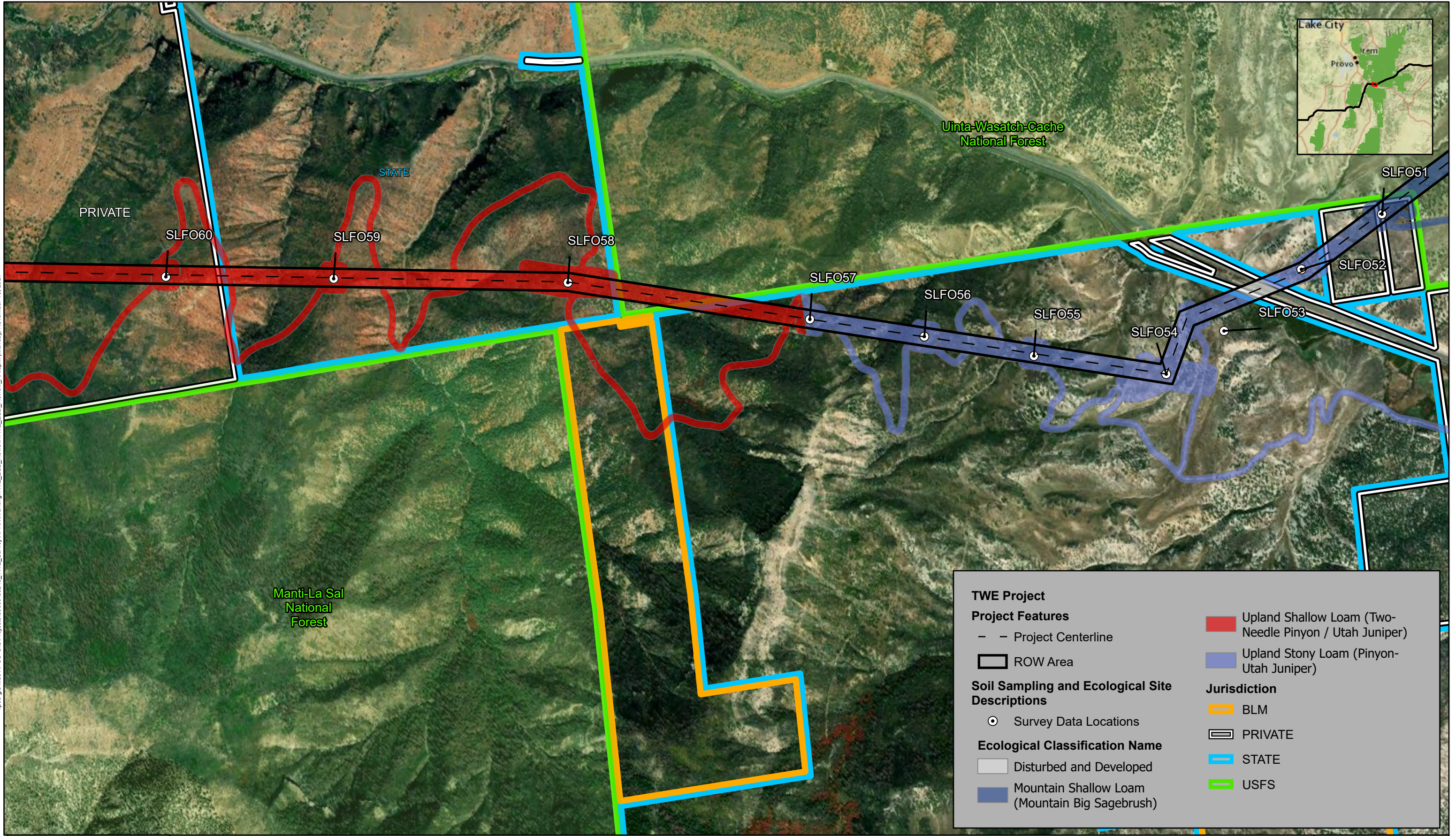
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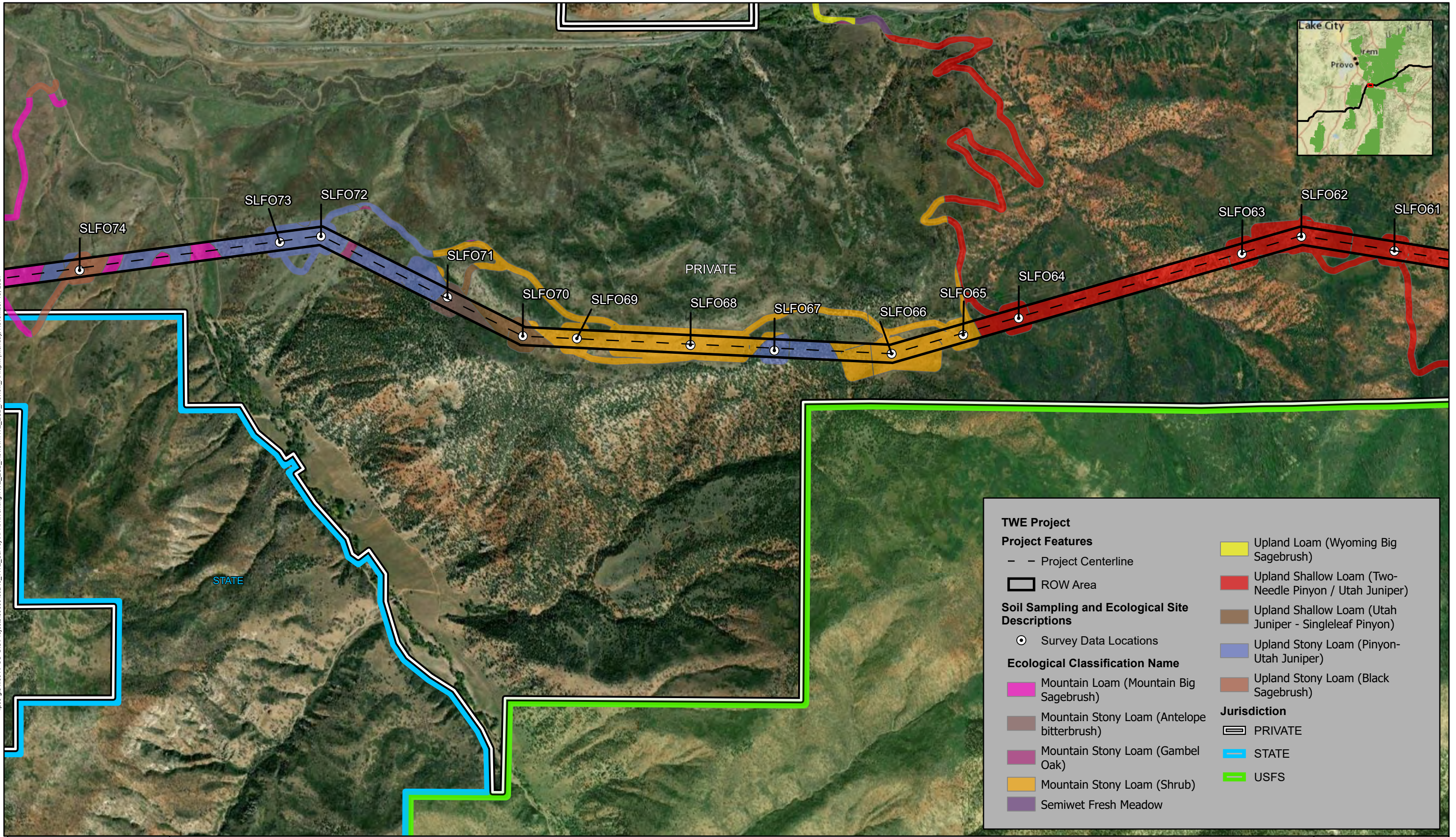


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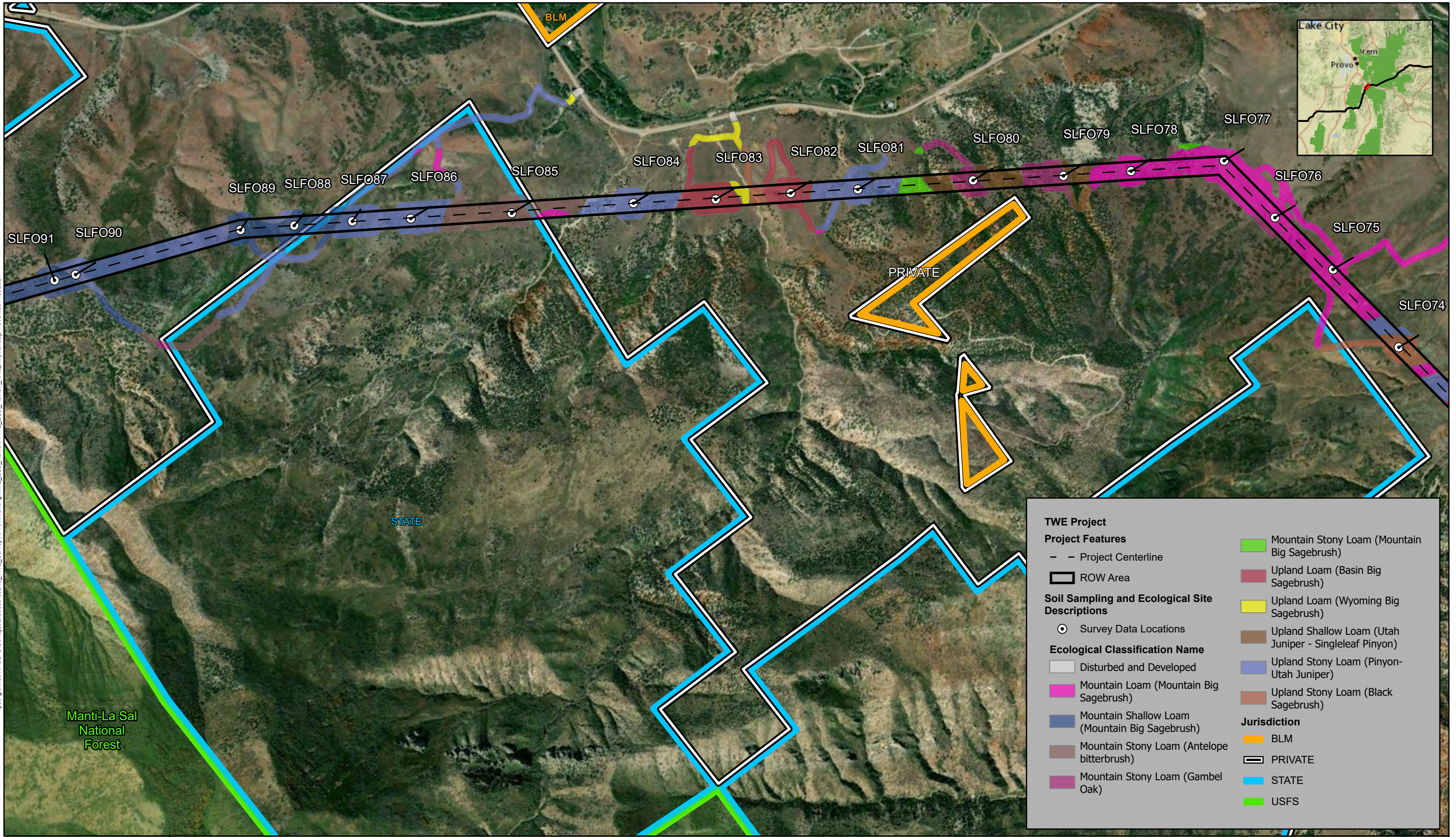
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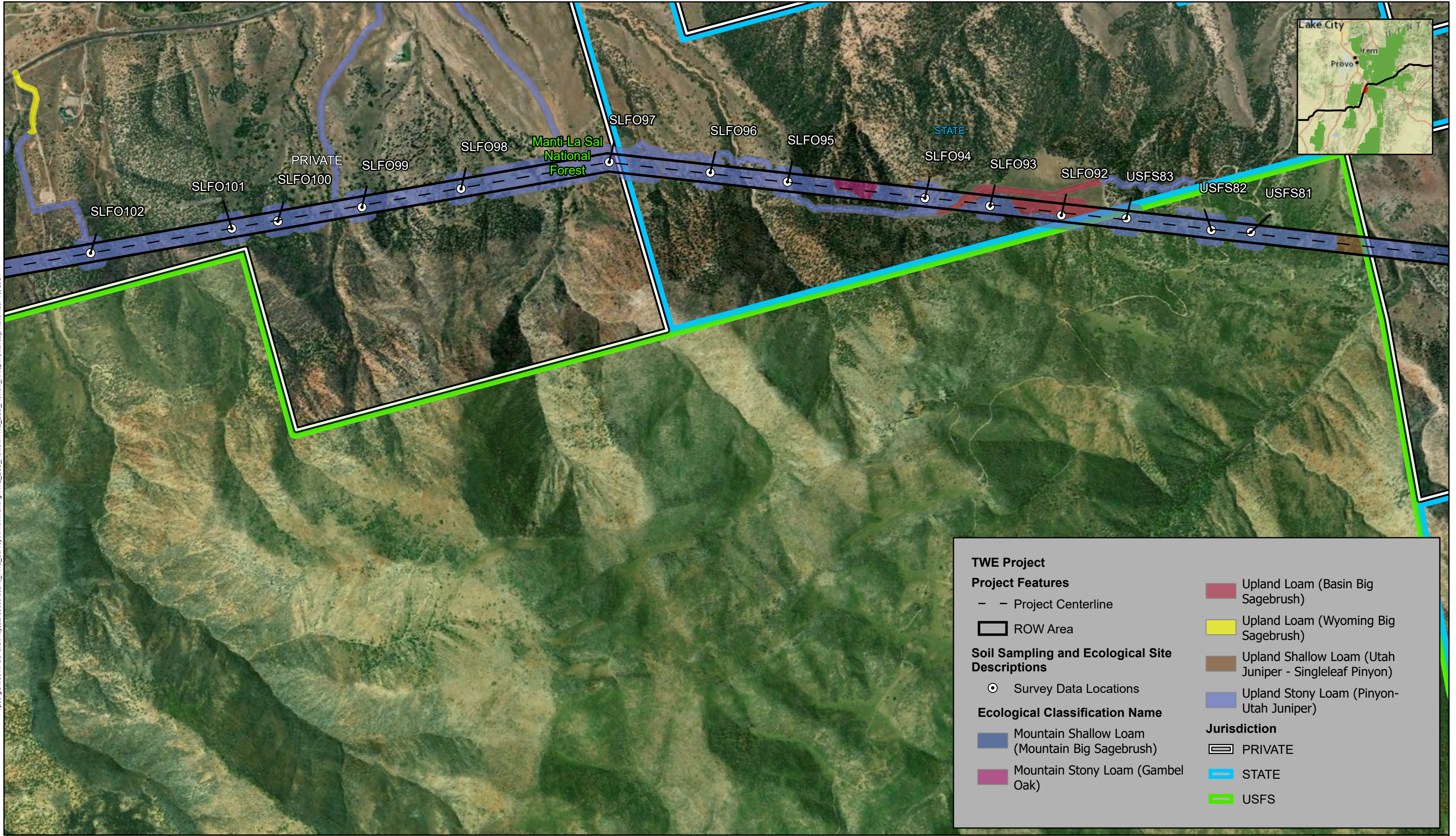
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Map 12 of 18

Ecological Site Descriptions - United States Forest Service
TransWest Express Transmission Project



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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- Survey Data Locations

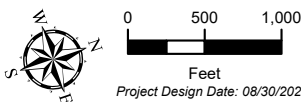
Ecological Classification Name

- Mountain Shallow Loam (Mountain Big Sagebrush)
- Mountain Stony Loam (Gambel Oak)

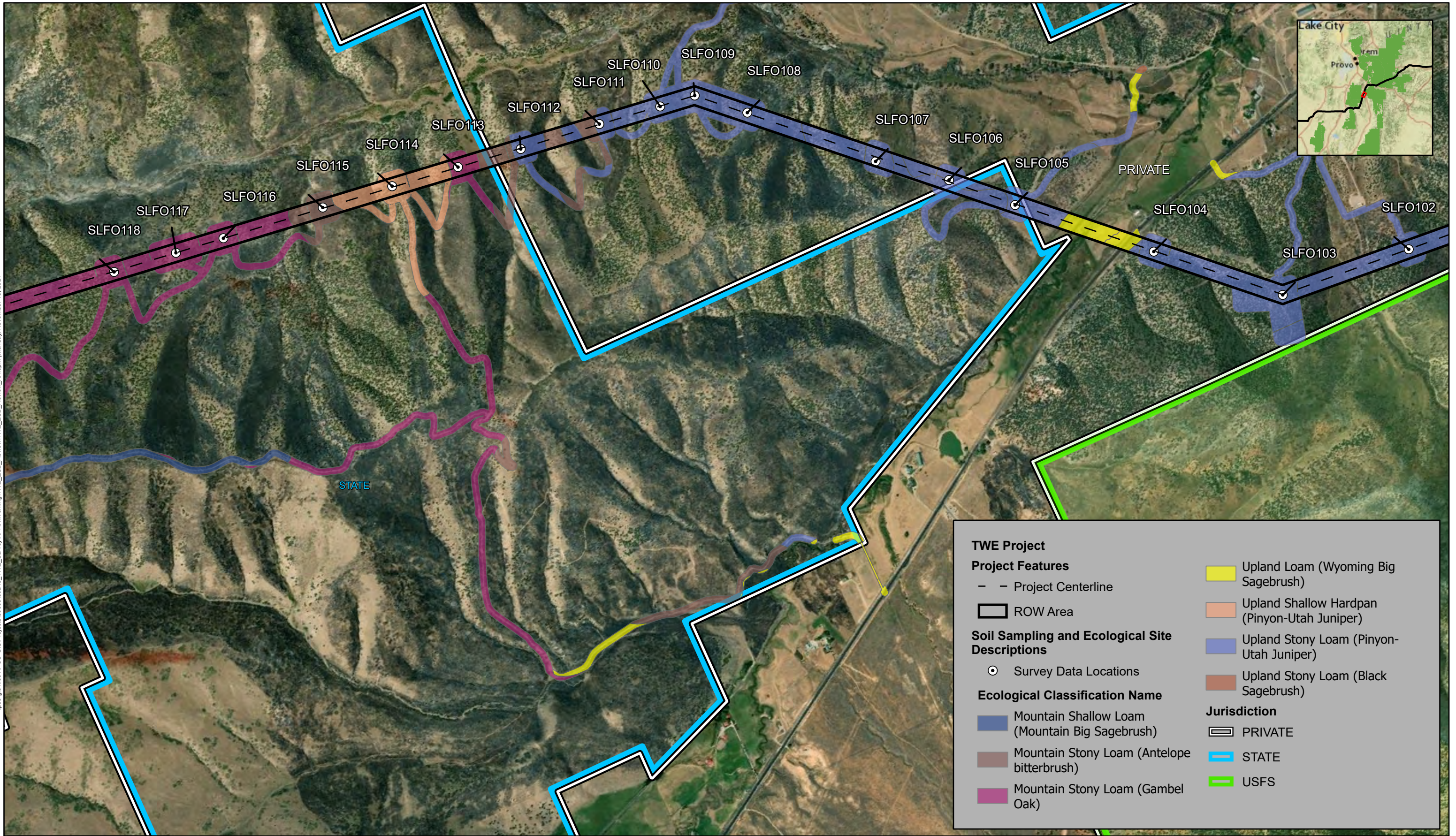
- Upland Loam (Basin Big Sagebrush)
- Upland Loam (Wyoming Big Sagebrush)
- Upland Shallow Loam (Utah Juniper - Singleleaf Pinyon)
- Upland Stony Loam (Pinyon-Utah Juniper)

Jurisdiction

- PRIVATE
- STATE
- USFS

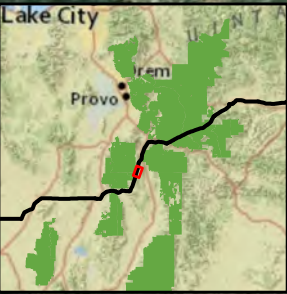
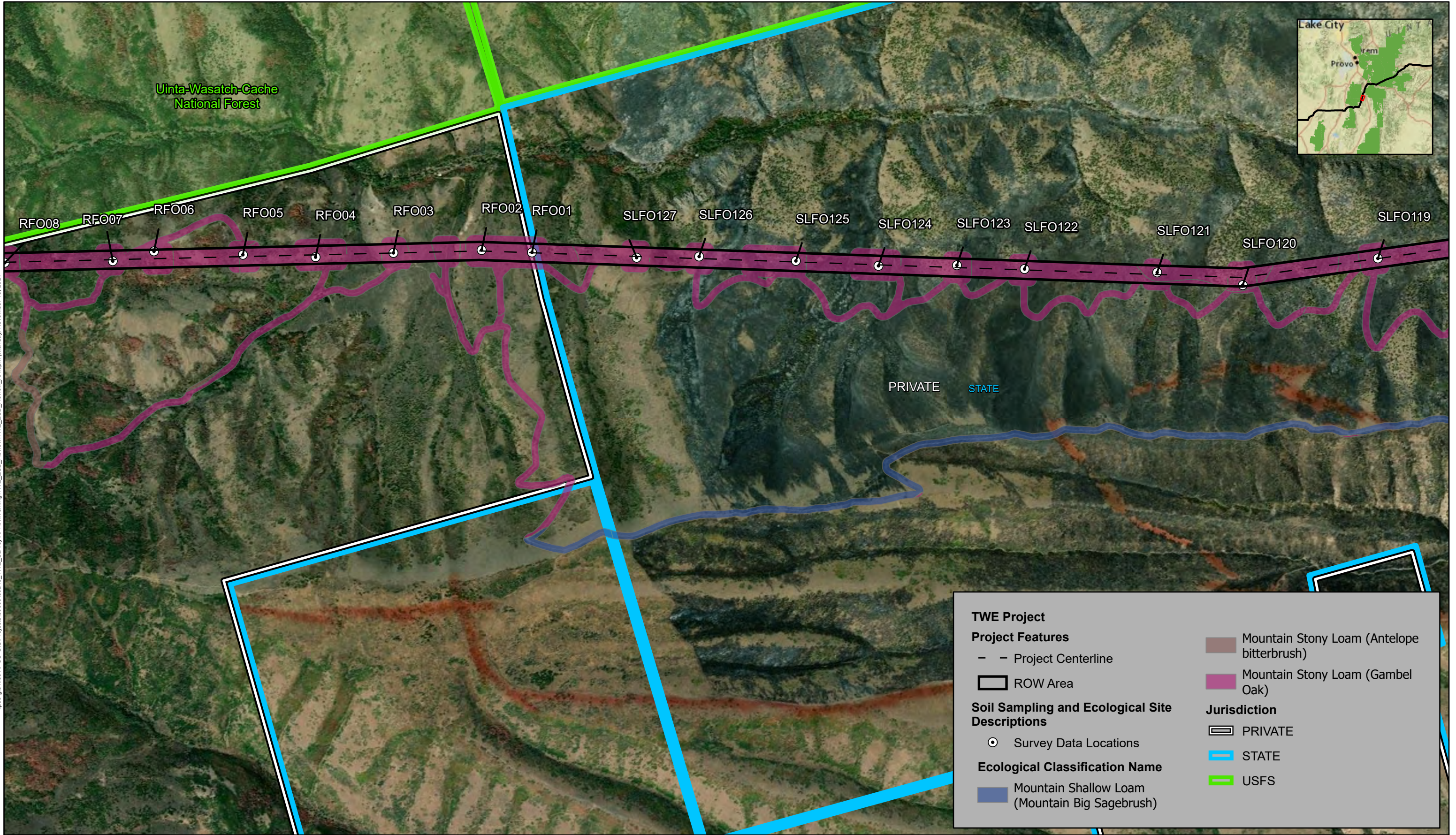


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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- ⊙ Survey Data Locations

Ecological Classification Name

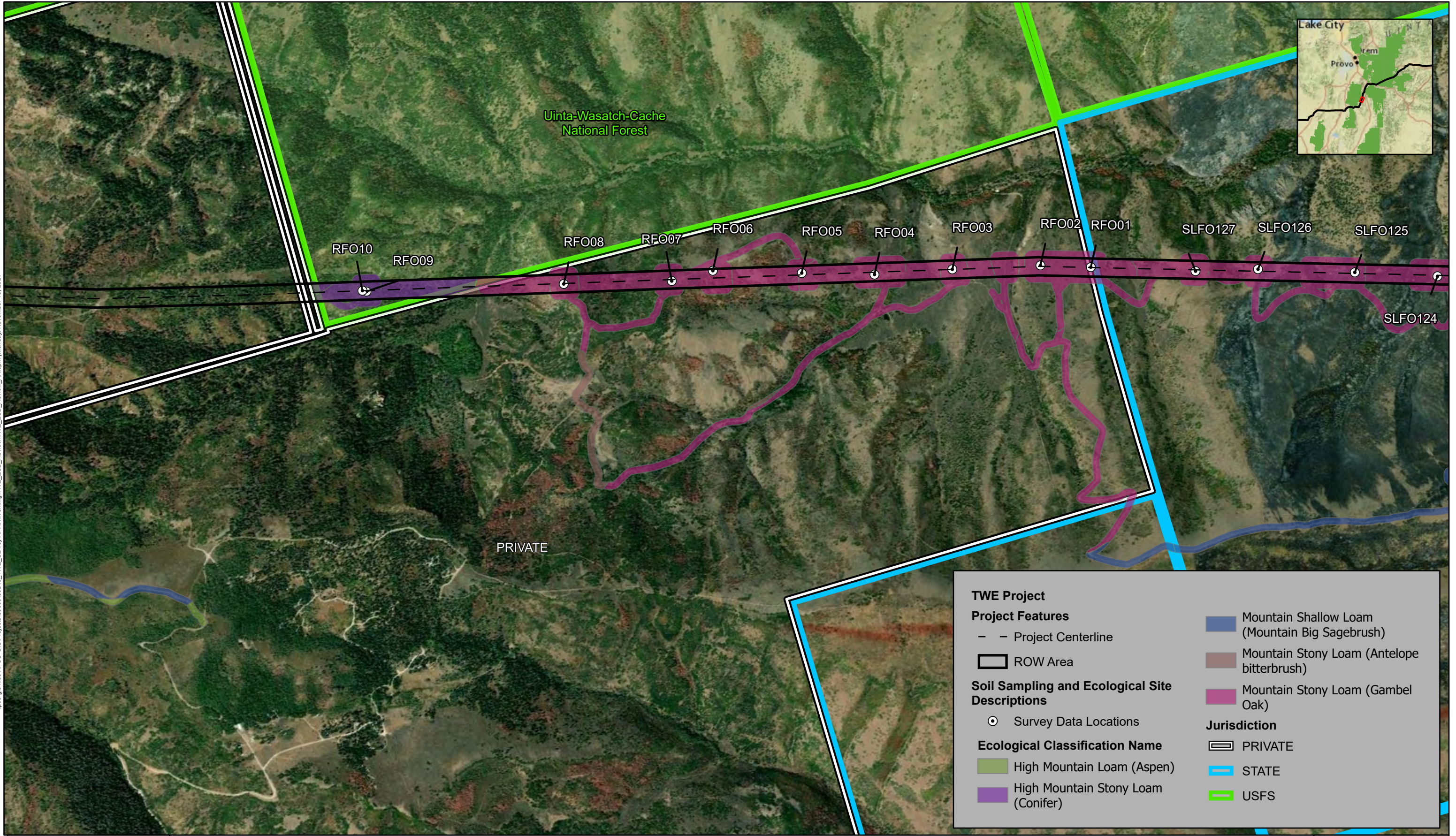
- Mountain Shallow Loam (Mountain Big Sagebrush)

- Mountain Stony Loam (Antelope bitterbrush)
- Mountain Stony Loam (Gambel Oak)

Jurisdiction

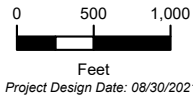
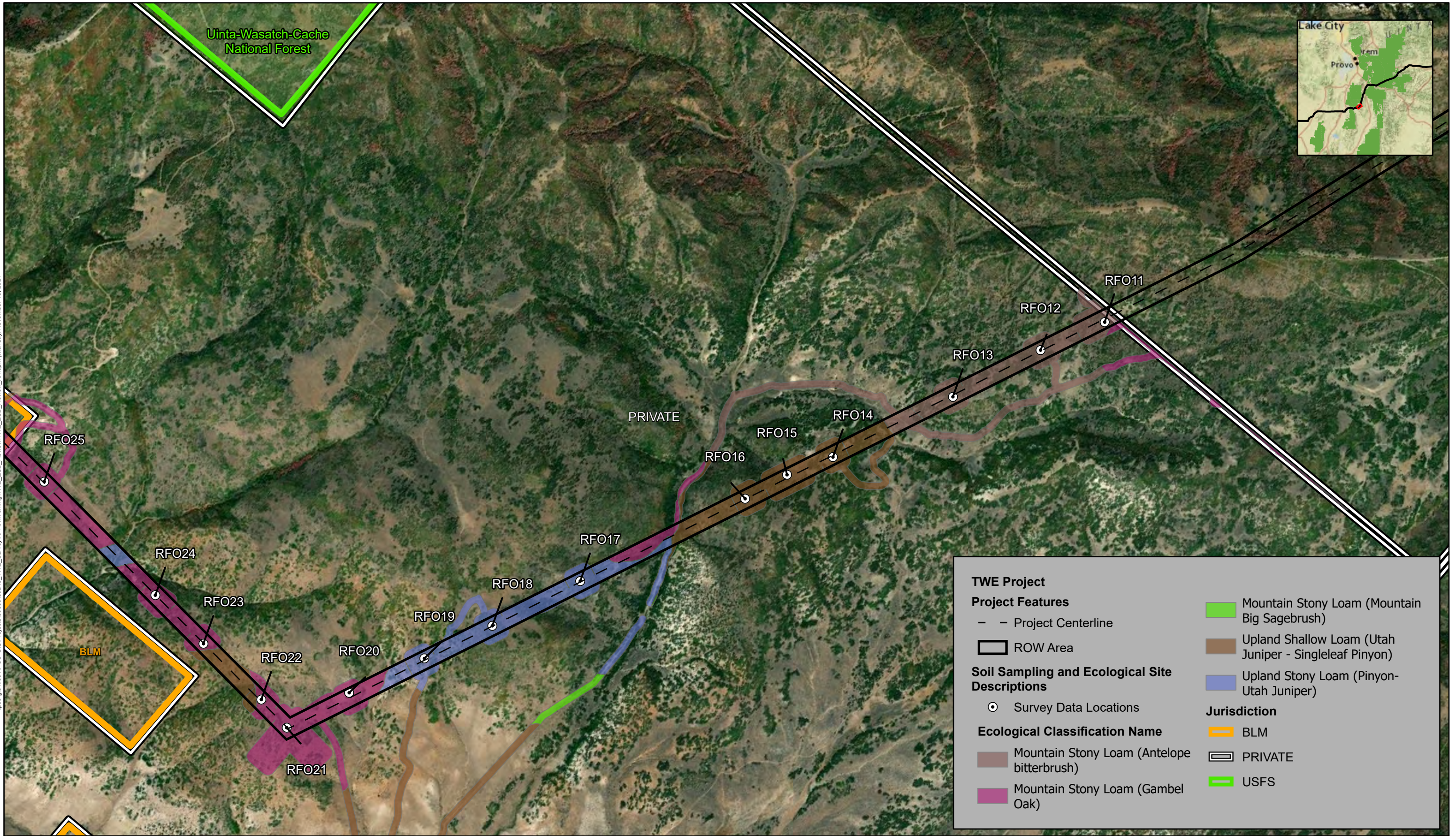
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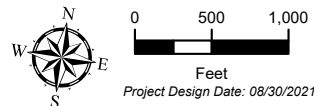
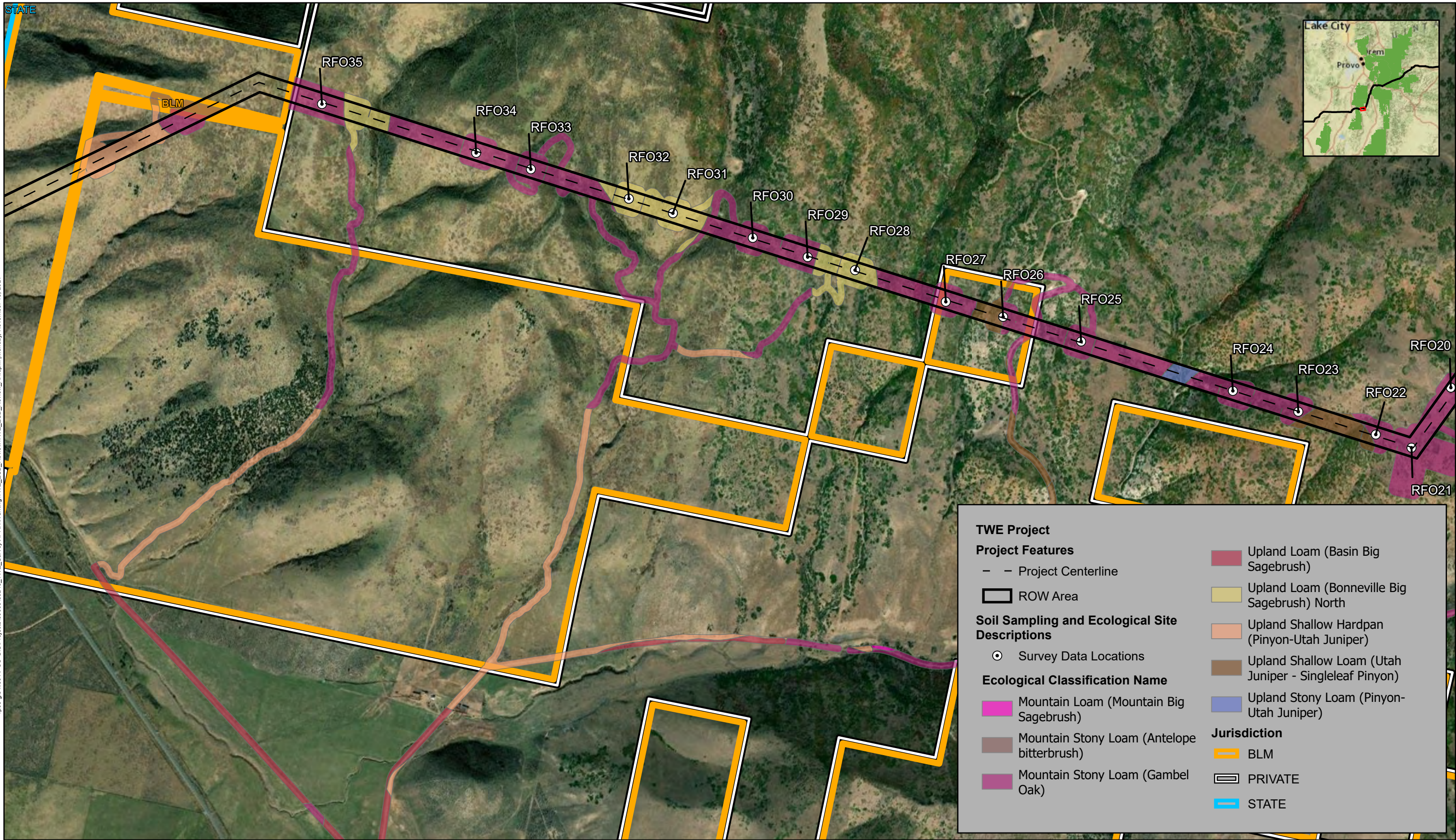


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APPENDIX F

Fillmore Field Office Ecological Site Descriptions

1.0 ENVIRONMENTAL SETTINGS

1.1 Wasatch Mountains North Major Land Resource Area

In Utah, the TransWest Express Transmission Project (TWE Project) is in the Wasatch Mountains North Major Land Resource Area (MLRA) (MLRA-47X). Elevation ranges from approximately 4,900 (1,495 meters) to 13,500 feet (4,115 meters). The average annual precipitation in most of this MLRA is 15 to 30 inches (380 to 760 millimeters). It can be as much as 73 inches (1,855 millimeters) at the higher elevations. Peak precipitation occurs in the winter months. The higher elevations receive significant amounts of snowfall each year. The average annual temperature is 30 degrees Fahrenheit (°F) to 58°F (-1 to 15 degrees Celsius). The frost-free period averages 140 days and ranges from 60 to 220 days, generally decreasing in length with elevation. In the Wasatch Mountains North, about 22% of water is from groundwater sources, and 78% is from surface water sources. Low levels of salts occur in the groundwater closest to the recharge areas along the base of the mountains, while briny water occurs in the deeper parts of these deposits.

This region consists of diverse geology. The mountains in this MLRA are primarily fault blocks that have been tilted up. Alluvial fans at the base of the mountains are recharge zones for the basin fill aquifer and are significant sources of sand and gravel for construction. An ancient shoreline of historic Lake Bonneville is evident on the footslopes along the western edge of the MLRA. Rocks exposed in the mountains are mostly Mesozoic and Paleozoic sediments, but Precambrian rocks are exposed in the Uinta Mountains. The Uinta Mountains are among the few ranges in the United States that are oriented west to east. Younger igneous rocks (ash and lava) are found throughout the MLRA. Lava-capped mesas are common in the southern part of the area. The southern Wasatch Mountains consist of Tertiary volcanic rocks occurring as extrusive lava and intrusive crystalline rocks. The dominant soil orders in this MLRA are Aridisols, Entisols, Inceptisols, and Mollisols. The soils in the MLRA dominantly have a frigid soil temperature regime on plateaus and the lower mountain slopes and a cryic soil temperature regime at the higher elevations. They have a mesic soil temperature regime at the lowest elevations, on south-facing slopes. The soil moisture regime is typically xeric.

The composition of vegetation within this region varies with elevation. The zone above an elevation of about 13,000 feet (3,965 meters) supports alpine meadows. Coniferous forests of Engelmann spruce (*Picea engelmannii*), white fir (*Abies concolor*), subalpine fir (*Abies lasiocarpa*), and Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) dominate the mid to high elevations. The most common understory plants in these forests are Oregon grape (*Mahonia aquifolium*), Oregon boxleaf (*Paxistima myrsinites*), and heartleaf arnica (*Arnica cordifolia*). The part of the MLRA in the Uinta Mountains includes significant amounts of lodgepole pine (*Pinus contorta*), and the southern part of the Wasatch Mountains includes significant amounts of ponderosa pine (*Pinus ponderosa*). Forests of quaking aspen (*Populus tremuloides*) commonly have an understory that includes blue wildrye (*Elymus glaucus*), mountain brome (*Bromus marginatus*), Fendler's meadowrue (*Thalictrum fendleri*), and aspen peavine (*Lathyrus lanszwertii*). Bluebunch wheatgrass (*Pseudoroegneria spicata*), bearded wheatgrass (*Elymus caninus*), blue wildrye, mountain brome, and numerous forbs grow in the understory in areas of Gambel oak (*Quercus gambelii*), curl-leaf (*Cercocarpus ledifolius*) and birchleaf (*Cercocarpus betuloides*) mountain mahogany, common snowberry (*Symphoricarpos albus*), and serviceberry (*Amelanchier* spp.). Big sagebrush (*Artemisia tridentata*) and bluebunch wheatgrass are the dominant species in the sagebrush-grass plant communities that are common at the lowest elevations.

1.2 Great Salt Lake Area Major Land Resource Area

In Utah, the TWE Project is also located in the Great Salt Lake Area MLRA (MLRA-28A). Elevation ranges from 3,950 to 6,560 feet (1,205 to 2,000 meters) in the basins and from 6,560 to 11,150 feet

(2,000 to 3,400 meters) in the mountains. The average annual precipitation is 5 to 12 inches (125 to 305 millimeters) in the valleys and is as much as 49 inches (1,245 millimeters) in the mountains. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The driest period is from midsummer to early autumn. Precipitation in winter typically occurs as snow. The average annual temperature is 39°F to 53°F (4 to 12 degrees Celsius). The frost-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with elevation. Water is scarce in this region. For the most part, streams are small and intermittent and depend on sources in the higher mountains. Reservoirs are used to store water in the mountains east of this area for irrigation in the flatter areas of this MLRA.

The dominant soil orders in the MLRA are Aridisols, Entisols, and Mollisols. The soils in the MLRA dominantly have a mesic or frigid soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are well drained or somewhat excessively drained, loamy or loamy-skeletal, and very deep. Calcixerolls formed in alluvium on alluvial fan remnants and lake terraces (Abela series) and in alluvium and lacustrine sediments on lake terraces (Collinston series). Moderately deep Haploxerolls (Middle series) formed in residuum on mountain slopes. Deep and very deep Haploxerolls (Ririe and Rexburg series) formed in loess and silty alluvium on fans, terraces, foothills, and basalt plains. Shallow Haploxerolls (Hymas series) to very deep Haploxerolls (Hondoho series) formed in colluvium and residuum derived from limestone on mountains and foothills. Torriorthents formed in alluvium on alluvial fans and beach plains (Cliffdown series) and in alluvium mixed with lacustrine sediments on alluvial flats and fans, lake terraces, and lake plains (Timpie and Tooele series). Poorly drained Aquisalids (Saltair series) formed in alluvium and lacustrine sediments on lake plains and basin floors. Torripsamments (Yenrab series) formed in sandy eolian material on dunes. Haplocalcids formed in residuum on hills and mountains (shallow Amtoft series); in alluvium and colluvium on alluvial fans, terraces, and hills (Hiko Peak series); in mixed alluvium and lacustrine sediments on alluvial fans, terraces; and lake plains (Taylorsflat series); and in lacustrine sediments on lake terraces (Thiokol series). Natrargids (Skumpah series) formed in alluvium on alluvial fans and flats.

This area supports desert shrub, sagebrush semidesert, and woodland vegetation. In areas where the average annual precipitation is less than about 200 millimeters, the soils support shadscale saltbush (*Atriplex confertifolia*), winterfat, black sagebrush (*Artemisia nova*), and associated grasses, such as Indian ricegrass (*Achnatherum hymenoides*) and squirreltail (*Elymus elymoides*). Greasewood (*Sarcobatus vermiculatus*) and Nuttall's saltbush (*Atriplex nuttallii*) grow on soils having a high content of salts or sodium. In areas where the average annual precipitation is 200 to 300 millimeters, the soils support big sagebrush, shadscale saltbush, winterfat, and associated grasses, such as bluebunch wheatgrass, Indian ricegrass, and bluegrasses (*Poa* spp.). In areas where the average annual precipitation is more than 300 millimeters, the soils support Utah juniper (*Juniperus osteosperma*), singleleaf pinyon (*Pinus monophylla*), big sagebrush, bluebunch wheatgrass, bluegrasses, and needle and thread (*Hesperostipa comata*). A large, nearly barren area west of Great Salt Lake has a very sparse cover of pickleweed (*Salicornia* spp.), sapphire woollystar (*Eriastrum saphirinum*), seepweed (*Suaeda* spp.), and greasewood.

1.3 Ecological Site Distribution

Dominant ecological sites in the TWE Project right-of-way within the Fillmore Field Office (FO) include Alkali Flat (Black Greasewood) and Desert Salt Flat (Sickle Saltbush). Less prevalent ecological sites include Semiwet Fresh Streambank (Narrowleaf Cottonwood) and Wet Saline Meadow (Saltgrass). All ecological sites are located within BLM managed lands (Table F-1). A photograph of each ecological site is provided in Attachment F-1. Maps depicting the ecological site locations in the TWE Project right-of-way are provided in Attachment F-2.

TABLE F-1 ECOLOGICAL SITE DISTRIBUTION IN THE BLM FILLMORE FO

Ecological Site	Managing Agency	Right-of-Way Area (acres)	Temporary Work Area (acres)	New, Improved Existing, and Temporary Access Roads (acres)*
Alkali Flats		487.9	1,326.6	350.7
Alkali Bottom (Alkali Sacaton)	BLM	10.5	5.2	2.0
Alkali Flat (Black Greasewood)	BLM	106.8	581.9	122.3
Desert Salt Flat (Sickle Saltbush)	BLM	193.1	511.3	136.6
Desert Silt Loam (Winterfat)	BLM	177.5	228.2	89.8
Desert Alkali Bench		393.3	1,063.3	336
Desert Alkali Bench (Bud Sagebrush)	BLM	64.3	405.8	62.3
Desert Alkali Sand (Fourwing Saltbush)	BLM	12.4	42.4	8.1
Desert Flat (Shadscale)	BLM	168.8	340.8	119.8
Desert Gravelly Loam (Shadscale)	BLM	147.8	274.3	145.8
Mountain Loam		72.6	152.5	135.4
High Mountain Very Steep Loam (Engelmann Spruce)	BLM	3.6	17.5	2.7
Mountain Loam (Mountain Big Sagebrush)	BLM	0.1	1.0	5.3
Mountain Stony Loam (Antelope Bitterbrush)	BLM	24.0	63.0	41.4
Mountain Stony Loam (Mountain Big Sagebrush)	BLM	42.8	70.7	79.1
Semiwet Fresh Streambank (Narrowleaf Cottonwood)	BLM	2.1	0.3	6.9
Semidesert Loams		213.5	377.6	178.3
Semidesert Loam (Wyoming Big Sagebrush)	BLM	5.0	17.2	6.2
Semidesert Gravelly Loam (Wyoming Big Sagebrush) North	BLM	48.4	96.5	46.1
Semidesert Shallow Hardpan (Black Sagebrush)	BLM	9.8	26.5	8.9
Semidesert Shallow Loam (Black Sagebrush)	BLM	131.6	215.8	88.1
Semidesert Very Shallow Loam (Littleleaf Mountain Mahogany)	BLM	18.7	21.6	29.0
Stony Slopes		204.9	304.6	283.1
Upland Shallow Hardpan (Pinyon–Utah Juniper)	BLM	53.8	51.7	103.0
Upland Shallow Loam (Black Sagebrush)	BLM	18.8	67.1	14.8
Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon)	BLM	5.1	6.5	0.6
Upland Stony Loam (Pinyon–Utah Juniper)	BLM	33.0	47.4	56.0
Upland Stony Loam (Utah Juniper)	BLM	74.4	110.1	79.1
Upland Stony Loam (Wyoming Big Sagebrush)	BLM	19.8	21.8	29.6

* Acreage calculated using 100-foot buffer around Project access roads

1.4 Rangeland Analysis Platform

RAP was used to further assess the distribution and estimated cover of vegetation and cover types across the Project (NRCS and BLM 2021). RAP integrates data from NRCS's National Resources Inventory and BLM's Assessment, Inventory, and Monitoring and Landscape Monitoring Framework datasets. These quantitative vegetative assessments are modeled with historical Landsat satellite records, gridded meteorology data, and abiotic land surface data to provide estimates of the percent vegetation cover of different growth forms. RAP data were used to define the vegetation and abiotic characteristics for the Project and to develop reclamation success cover standards for each ecological site and DRG, as defined in Table F-2.

TABLE F-2 DRG RAP ATTRIBUTE DATA FOR THE BLM FILMORE FO

DRG	ESD	Forbs and Grasses - Annuals (%)	Forbs and Grasses - Perennial (%)	Woody (%)	Litter (%)	Bareground (%)
Alkali Flats	Alkali Bottom	6.2	10.6	16.9	10.5	43.3
	Alkali Flat	6.2	4.3	13.7	9.9	56.6
	Desert Salt Flat	2.5	2.3	9.7	5.5	75.0
	Desert Silt Loam	20.8	7.4	11.5	15.3	32.1
	SUBTOTAL	8.9	6.2	13.0	10.3	51.7
Desert Alkali Bench	Desert Alkali Bench	4.7	3.5	12.9	9.2	59.9
	Desert Alkali Sand	5.1	5.3	16.1	10.5	50.3
	Desert Flat	4.6	2.9	10.6	7.0	67.2
	Desert Gravelly Loam	16.4	7.8	13.3	14.1	33.6
	Desert Sandy Loam	4.0	3.6	12.8	9.1	56.6
	Desert Shallow Loam	20.0	7.0	12.9	14.1	30.1
	SUBTOTAL	9.1	5.0	13.1	10.7	49.6
Mountain Loams	High Mountain Very Steep Loam	1.2	18.5	59.5	12.3	2.2
	Mountain Loam - MBS	7.2	30.1	27.9	16.3	13.0
	Mountain Loam - Shrub	2.0	24.9	54.3	10.2	3.9
	Mountain Shallow Loam - Mountain Big Sagebrush	1.4	24.5	60.6	7.6	2.5
	Mountain Stony Loam - Antelope Bitterbrush	4.8	22.6	50.6	10.5	5.6
	Mountain Stony Loam - Mountain Big Sagebrush	4.2	25.0	45.1	13.0	8.0
	Semiwet Fresh Streambank	5.9	24.3	37.9	13.4	9.2
	Upland Loam - Bonneville	9.5	16.8	23.3	15.4	20.3
	SUBTOTAL	4.5	23.3	44.9	12.4	8.1
Pasture and Hayland	Pasture and Hayland	26.7	19.1	9.2	16.9	20.8
	SUBTOTAL	26.7	19.1	9.2	16.9	20.8

DRG	ESD	Forbs and Grasses - Annuals (%)	Forbs and Grasses - Perennial (%)	Woody (%)	Litter (%)	Bareground (%)
Semidesert Loams	Semidesert Gravelly Loam	18.2	9.3	13.0	14.5	31.6
	Semidesert Loam	18.8	15.9	12.9	17.4	26.1
	Semidesert Shallow Hardpan - Black Sagebrush	27.3	19.5	10.1	17.4	17.2
	Semidesert Shallow Hardpan - Utah Juniper	12.0	12.0	22.2	15.5	21.5
	Semidesert Shallow Loam	20.1	10.5	13.9	14.4	22.4
	Semidesert Very Shallow Loam	2.0	28.6	53.5	8.5	3.1
	SUBTOTAL	16.4	16.0	20.9	14.6	20.3
Stony Slopes	Upland Shallow Hardpan	9.9	15.0	23.5	15.1	20.0
	Upland Shallow Loam - Black Sagebrush	17.4	15.9	18.1	15.4	18.5
	Upland Shallow Loam - Utah Juniper	3.3	29.7	48.1	9.4	5.0
	Upland Stony Loam - Pinyon-Juniper	7.6	12.7	30.1	15.0	14.9
	Upland Stony Loam - Utah Juniper	3.6	11.7	39.5	12.6	12.3
	Upland Stony Loam - Wyoming Big Sagebrush	7.6	16.3	27.8	13.5	19.5
	SUBTOTAL	8.2	16.9	31.2	13.5	15.0

Source: NRCS and BLM 2021

2.0 INDIVIDUAL ECOLOGICAL SITE DESCRIPTIONS

2.1 Alkali Bottom (Alkali Sacaton) Ecological Site Description

Alkali Bottom (Alkali Sacaton) ecological sites in the TWE Project within the Fillmore FO are typically located on lake plains, lake terraces, valley floors, floodplains, alluvial flats, and in depressional areas within lake terraces. It typically occupies the elevational area just above lake playas and just below the Alkali Flat ecological site. Slopes typically range from 0% to 2% but may occasionally reach 3% (NRCS 2020a). The soils on this site were formed in alluvium and/or lacustrine deposits derived mainly from mixed sources including sandstone, shale, and sedimentary rock parent material. The soil series within this ecological site in the TWE Project boundary include Uvada, Skumpah, Kanosh, and Bramwell. Precipitation ranges between 12 to 18 inches annually in Alkali Bottom (Alkali Sacaton) ecological sites (NRCS 2020a).

2.1.1 Soil Characteristics

Alkali Bottom (Alkali Sacaton) ecological sites are very deep and poorly to somewhat poorly drained (Table F-3; NRCS 2020a). Topsoil textures include loam to silt loam. Topsoil depth is 5.50 ± 3.11 inches. Subsoil textures range from silty clay loam to fine sandy loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity (electrical conductivity $[\text{EC}] > 4.0$ deciSiemens per meter $[\text{dS/m}]$), and sodicity (sodium adsorption ratio $[\text{SAR}] > 12.0$) may limit vegetation growth in some areas (see Table F-3).

TABLE F-3 SOIL CHARACTERISTICS TYPICAL OF ALKALI BOTTOM (ALKALI SACATON) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium and/or lacustrine deposits derived mainly from mixed sources including sandstone, shale, and sedimentary rock parent material
Topsoil depth	5.50 ± 3.11
Topsoil texture	Loam to silt loam
Topsoil fragments	None
Topsoil pH	8.5–8.8
Topsoil salinity (EC)	0–32 dS/m
Topsoil sodicity (SAR)	0–40
Subsoil texture	Silty clay loam to fine sandy loam
Subsoil fragments	None
Subsoil pH	8.4–9.3
Subsoil salinity (EC)	0–32 dS/m
Subsoil sodicity (SAR)	0–30

Source: NRCS (2020a, 2020d)

2.1.2 Vegetation

Potential vegetation growth form composition in Alkali Bottom (Alkali Sacaton) ecological sites is 85% grasses or grass-like plants, 5% forbs, and 10% woody plants (Table F-4; NRCS 2020a). The major grass species found at this site include saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), basin wildrye (*Leymus cinereus*), and Douglas' sedge (*Carex douglasii*). Other commonly occurring grasses include squirreltail, foxtail barley (*Hordeum jubatum*), beardless wildrye (*Leymus triticoides*), mat muhly (*Muhlenbergia richardsonis*), western wheatgrass (*Pascopyrum smithii*), Nuttall's alkaligrass (*Puccinellia nuttalliana*) and alkali cordgrass (*Spartina gracilis*). The dominant woody species is greasewood. Subdominant woody species found at this site include iodinebush (*Allenrolfea occidentalis*), basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), fourwing saltbush (*Atriplex canescens*), Gardner's saltbush (*Atriplex gardneri*), basin saltbush (*Atriplex tridentata*), whiteflower rabbitbrush (*Chrysothamnus albidus*), and skunkbush sumac (*Rhus trilobata*) (NRCS 2020a).

TABLE F-4 VEGETATION CHARACTERISTICS TYPICAL OF ALKALI BOTTOM (ALKALI SACATON) ECOLOGICAL SITES

Growth Form	Composition
Grasses	85%
Forbs	5%
Shrubs	10%

Source: NRCS (2020a)

2.2 Alkali Flat (Black Greasewood) Ecological Site Description

Alkali Flat (Black Greasewood) ecological sites in the TWE Project within the Fillmore FO are located on lake plains, lake terraces, floodplains, alluvial flats, and fan remnants. It occupies the elevational area just above the Loamy Bottom or Alkali Bottom ecological sites and just below the Alkali Loam ecological site. Slopes range from 0% to 5% but may occasionally reach 8% (NRCS 2020a). The soils on this site were formed in alluvium and/or lacustrine deposits derived mainly from mixed sources including sandstone, shale, and sedimentary rock parent material. The soil series within this ecological site in the

TWE Project boundary include Abraham, Anco, Checkett, Poganeab, Yuba, Wasey Mazuma, and Uvada. Precipitation ranges between 8 to 12 inches annually in Alkali Flat (Black Greasewood) ecological sites (NRCS 2020a).

2.2.1 Soil Characteristics

Alkali Flat (Black Greasewood) ecological sites are deep and mostly moderately well to well drained (Table F-5; NRCS 2020a). Topsoil textures range from loam to silty clay loam. Topsoil average depth is approximately 5.90 ± 1.79 inches. Subsoil textures range from clay loam to silty clay loam (NRCS 2020a). Soil pH (> 8.1), salinity (> 4.0 dS/m), and sodicity (> 12.0) may limit vegetation growth in some areas (see Table F-5).

TABLE F-5 SOIL CHARACTERISTICS TYPICAL OF ALKALI FLAT (BLACK GREASEWOOD) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium and/or lacustrine deposits derived mainly from mixed sources including sandstone, shale, and sedimentary rock parent material
Topsoil depth	5.90 ± 1.79
Topsoil texture	Loam to silty clay loam
Topsoil fragments	3% stones, 23% cobbles, 20% gravel
Topsoil pH	8.2–9.0
Topsoil salinity (EC)	4–16 dS/m
Topsoil sodicity (SAR)	0–32
Subsoil texture	Clay loam to silty clay loam
Subsoil fragments	3% stones, 23% cobbles, 20% gravel
Subsoil pH	8.4–9.0
Subsoil salinity (EC)	4–16 dS/m
Subsoil sodicity (SAR)	0–32

Sources: NRCS (2020a, 2020d)

2.2.2 Vegetation

Potential vegetation growth form composition in Alkali Flat (Black Greasewood) ecological sites is 20% grasses or grass-like plants, 10% forbs, and 70% woody plants (Table F-6; NRCS 2020a). The major grass species found at this site is bottlebrush squirreltail. Other commonly occurring grasses include saltgrass, basin wildrye, and alkali sacaton. Dominant woody species include black greasewood, winterfat, and shadscale saltbush (NRCS 2020a).

TABLE F-6 VEGETATION CHARACTERISTICS TYPICAL OF ALKALI FLAT (BLACK GREASEWOOD) ECOLOGICAL SITES

Growth Form	Composition
Grasses	20%
Forbs	10%
Shrubs	70%

Source: NRCS (2020a)

2.3 Desert Salt Flat (Sickle Saltbush) Ecological Site Description

Desert Salt Flat (Sickle Saltbush) ecological sites in the TWE Project within the Fillmore FO are located on low, run-in valley bottoms and playa lakes, lake deltas, lake plains, and floodplains where extra moisture accumulates. This site can also occur on lake terraces where the water table is not apparent within 60 inches of the soil surface. Slopes range from 0% to 3% but may occasionally reach 8% (NRCS 2020a). The soils on this site were formed in alluvium and lake sediments derived mainly from mixed sedimentary and igneous parent materials. The soil series within this ecological site in the TWE Project boundary include Abraham, Goshute, Saltair, Yuba, and Uvada. Precipitation ranges between 5 to 8 inches annually in Desert Salt Flat (Sickle Saltbush) ecological sites (NRCS 2020a).

2.3.1 Soil Characteristics

Desert Salt Flat (Sickle Saltbush) ecological sites are deep and mostly moderately well to well drained (Table F-7; NRCS 2020a). Topsoil textures include silt loams or silty clay loams. Average topsoil depth is approximately 4.20 ± 1.94 inches. Subsoil textures range from loam to silty clay loam (NRCS 2020a). Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table F-7).

TABLE F-7 SOIL CHARACTERISTICS TYPICAL OF DESERT SALT FLAT (SICKLE SALTBUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium and lake sediments derived mainly from mixed sedimentary and igneous parent materials
Topsoil depth	4.20 ± 1.94
Topsoil texture	Silt loam to silty clay loam
Topsoil fragments	None
Topsoil pH	8.2–8.9
Topsoil salinity (EC)	2–32 dS/m
Topsoil sodicity (SAR)	0–90
Subsoil texture	Loam to silty clay loam
Subsoil fragments	None
Subsoil pH	8.2–9.0
Subsoil salinity (EC)	2–32 dS/m
Subsoil sodicity (SAR)	0–90

Sources: NRCS (2020a, 2020d)

2.3.2 Vegetation

Potential vegetation growth form composition in Desert Salt Flat (Sickle Saltbush) ecological sites is 20% grasses or grass-like plants, 10% forbs, and 70% woody plants (Table F-8; NRCS 2020a). The major grass species found at this site is bottlebrush squirreltail. Other commonly occurring grasses include James' galleta, Sandberg bluegrass, and alkali sacaton, and saltgrass. Dominant woody species include sickle saltbush (*Atriplex falcata*) and green molly (*Bassia americana*). Subdominant woody species found at this site include iodinebush, shadscale saltbush, and greasewood (NRCS 2020a).

TABLE F-8 VEGETATION CHARACTERISTICS TYPICAL OF DESERT SALT FLAT (SICKLE SALTBUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	20%
Forbs	10%
Shrubs	70%

Source: NRCS (2020a)

2.4 Desert Silt Loam (Winterfat) Ecological Site Description

Desert Silt Loam (Winterfat) ecological sites in the TWE Project within the Fillmore FO occur on alluvial flats, alluvial fans, valley floors and deltas. It is found on very gentle to flat slopes between 0% and 2% (NRCS 2020a). The soils on this site were formed in alluvium and residuum derived mainly from lacustrine parent materials. The soil series within this ecological site in the TWE Project boundary include Checkett, Uvada, and Skumpah. The climate is cold and snowy in the winter and warm and dry in the summer. Precipitation in Desert Silt Loam (Winterfat) ecological sites averages between 5 to 8 inches annually (NRCS 2020a).

2.4.1 Soil Characteristics

Desert Silt Loam (Winterfat) ecological sites are characteristically over 60 inches deep and well drained. The permeability of these soils is moderate to moderately rapid. There is no ponding or flooding on this site (Table F-9; NRCS 2020a). Topsoil textures range from loam to silt loam. Average topsoil depth is approximately 3.30 ± 1.76 inches. Subsoil textures range from silty clay loam to silty clay (NRCS 2020a). Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table F-9).

TABLE F-9 SOIL CHARACTERISTICS TYPICAL OF DESERT SILT LOAM (WINTERFAT) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium and residuum derived mainly from lacustrine parent materials
Topsoil depth	3.30 ± 1.76 inches
Topsoil texture	Loam to silt loam
Topsoil fragments	20% gravel, 23% cobbles, 3% stones
Topsoil pH	8.4–8.6
Topsoil salinity (EC)	0–32 dS/m
Topsoil sodicity (SAR)	0–70
Subsoil texture	Silty clay loam to silty clay
Subsoil fragments	23% cobbles, 3% stones, 20% gravel
Subsoil pH	8.4–8.6
Subsoil salinity (EC)	0–32 dS/m
Subsoil sodicity (SAR)	0–70

Sources: NRCS (2020a, 2020d)

2.4.2 Vegetation

Potential vegetation growth form composition in Desert Silt Loam (Winterfat) ecological sites is 20% grasses or grass-like plants, 5% forbs, and 75% woody plants (Table F-10; NRCS 2020a). The major

grass species found at this site include Indian ricegrass, squirreltail, James' galleta, and sand dropseed. Dominant woody species found at this ecological site include winterfat, bud sagebrush, and shadscale saltbush. Subdominant woody species include fourwing saltbush, yellow rabbitbrush, Nevada jointfir, broom snakeweed, and shortspine horsebrush (*Tetradymia spinosa*) (NRCS 2020a).

TABLE F-10 VEGETATION CHARACTERISTICS TYPICAL OF DESERT SILT LOAM (WINTERFAT) ECOLOGICAL SITES

Growth Form	Composition
Grasses	20%
Forbs	5%
Shrubs	75%

Source: NRCS (2020a)

2.5 Desert Alkali Bench (Bud Sagebrush) Ecological Site Description

Desert Alkali Bench (Bud Sagebrush) ecological sites in the TWE Project within the Fillmore FO typically occur on benches, gently sloping outwash fans, old lake terraces, lake plains, beach bars, and plateaus. It is typically found at 2% to 8% slopes (NRCS 2020a). The soils on this site were formed in alluvium and colluvium and lacustrine materials derived mainly from mixed parent material by the wave action of ancient Lake Bonneville or by running water in streams or sheet flood. The soil series within this ecological site in the TWE Project boundary include Goshute, Mazuma, Penoyer, Uvada, Poganead, Swasey, Swingler, Skumpah, and Yenrab. Precipitation ranges between 5 to 8 inches annually in Desert Alkali Bench (Bud Sagebrush) ecological sites.

2.5.1 Soil Characteristics

Desert Alkali Bench (Bud Sagebrush) ecological sites are over 60 inches deep, are well or somewhat excessively drained, and permeability is moderate to moderately rapid (Table F-11; NRCS 2020a). Topsoil textures range from gravelly loam to loamy sand. These soils are affected by sodium. Average topsoil depth is approximately 6.00 ± 1.94 inches. Subsoil textures are characterized as silty clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-11).

TABLE F-11 SOIL CHARACTERISTICS TYPICAL OF DESERT ALKALI BENCH (BUD SAGE) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium and colluvium and lacustrine materials derived mainly from mixed parent material by the wave action of ancient Lake Bonneville or by running water in streams or sheet flood
Topsoil depth	6.00 ± 1.94 inches
Topsoil texture	Gravelly loam to loamy sand
Topsoil fragments	None
Topsoil pH	8.5–9.0
Topsoil salinity (EC)	0–16 dS/m
Topsoil sodicity (SAR)	0–30
Subsoil texture	Silty clay loam
Subsoil fragments	None
Subsoil pH	8.4–9.2

Soil Characteristics	Description
Subsoil salinity (EC)	0–16 dS/m
Subsoil sodicity (SAR)	0–30

Sources: NRCS (2020a, 2020d)

2.5.2 Vegetation

Potential vegetation growth form composition in Desert Alkali Bench (Bud Sagebrush) ecological sites is 30% grasses or grass-like plants, 10% forbs, and 60% woody plants (Table F-12; NRCS 2020a).

The major grass species found at this site include Indian ricegrass, squirreltail, and James' galleta. Other commonly occurring grasses include King's eyelashgrass (*Blepharidachne kingii*), Sandberg bluegrass, alkali sacaton, and sand dropseed. Dominant woody species found at this ecological site include bud sagebrush, shadscale saltbush, green molly, and Nevada jointfir. Subdominant woody species include spiny hopsage (*Grayia spinosa*), broom snakeweed, winterfat, and shortspine horsebrush (NRCS 2020a).

TABLE F-12 VEGETATION CHARACTERISTICS TYPICAL OF DESERT ALKALI BENCH (BUD SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	30%
Forbs	10%
Shrubs	60%

Source: NRCS (2020a)

2.6 Desert Alkali Sand (Fourwing Saltbush) Ecological Site Description

Desert Alkali Sand (Fourwing Saltbush) ecological sites in the TWE Project within the Fillmore FO typically occur on lake terraces, beach terraces, and lake planes. It is typically found at 0% to 15% slopes (NRCS 2020a). The soils on this site were formed in eolian derived mainly from mixed sedimentary parent materials. The soil series within this ecological site in the TWE Project boundary include Uffens and Yenrab. Precipitation ranges between 5 to 8 inches annually in Desert Alkali Sand (Fourwing Saltbush) ecological sites (NRCS 2020a).

2.6.1 Soil Characteristics

Desert Alkali Sand (Fourwing Saltbush) ecological sites are over 60 inches deep over bedrock, are somewhat excessively drained, and have rapid permeability (Table F-13; NRCS 2020a). Topsoil textures range from silt loam to loamy sand. Average topsoil depth is approximately 7.5 ± 9.0 inches. Subsoil textures are characterized as sandy clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-13).

TABLE F-13 SOIL CHARACTERISTICS TYPICAL OF DESERT ALKALI SAND (FOURWING SALTBUH) ECOLOGICAL SITES.

Soil Characteristics	Description
Parent material	Formed in eolian derived mainly from mixed sedimentary parent materials
Topsoil depth	7.5 ± 9.0 inches
Topsoil texture	Silt loam to loamy sand
Topsoil fragments	None

Soil Characteristics	Description
Topsoil pH	8.6–9.3
Topsoil salinity (EC)	0–8 dS/m
Topsoil sodicity (SAR)	0–30
Subsoil texture	Sandy clay loam
Subsoil fragments	None
Subsoil pH	8.8–9.3
Subsoil salinity (EC)	0–8 dS/m
Subsoil sodicity (SAR)	0–30

Sources: NRCS (2020a, 2020d)

2.6.2 Vegetation

Potential vegetation growth form composition in Desert Alkali Sand (Fourwing Saltbush) ecological sites is 40% grasses or grass-like plants, 10% forbs, and 50% woody plants (Table F-14; NRCS 2020a). The major grass species found at this site include Indian ricegrass and alkali sacaton. Other commonly occurring grasses include purple threeawn, squirreltail, needle and thread, western wheatgrass, James' galleta, and sand dropseed. Dominant woody species found at this ecological site include fourwing saltbush, yellow rabbitbrush, and greasewood. Subdominant woody species include burrobush (*Ambrosia dumosa*), basin big sagebrush, shadscale saltbush, mormon tea (*Ephedra viridis*), spiny hopsage, broom snakeweed, bud sagebrush, and littleleaf horsebrush (*Tetradymia glabrata*) (NRCS 2020a).

TABLE F-14 VEGETATION CHARACTERISTICS TYPICAL OF DESERT ALKALI SAND (FOURWING SALTBUSH) ECOLOGICAL SITES.

Growth Form	Composition
Grasses	40%
Forbs	10%
Shrubs	50%

Source: NRCS (2020a)

2.7 Desert Flat (Shadscale) Ecological Site Description

Desert Flat (Shadscale) ecological sites in the TWE Project within the Fillmore FO occur on lake plains, lake terraces, deltas, alluvial fans, and basin floors. It is typically found on low slopes between 0% to 4% (NRCS 2020a). The soils on this site were formed in lacustrine sediments and alluvium derived mainly from mixed parent materials. The soil series within this ecological site in the TWE Project boundary include Checkett, Goshute, Swinger, Uvada, and Skumpah. Precipitation ranges between 5 to 8 inches annually in Desert Flat (Shadscale) ecological sites (NRCS 2020a).

2.7.1 Soil Characteristics

Desert Flat (Shadscale) ecological sites are over 60 inches deep, are moderately well to well drained, and have moderately slow to very slow permeability (Table F-15; NRCS 2020a). Topsoil textures range from silt loam to silty clay loam. Average topsoil depth is approximately 4.00 ± 1.41 inches. Subsoil textures range from silty clay loam to silty clay (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-15).

TABLE F-15 SOIL CHARACTERISTICS TYPICAL OF DESERT FLAT (SHADSCALE) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in lacustrine sediments and alluvium derived mainly from mixed parent materials
Topsoil depth	4.00 ± 1.41 inches
Topsoil texture	Silt loam to silty clay loam
Topsoil fragments	None
Topsoil pH	8.4–9.0
Topsoil salinity (EC)	2–16 dS/m
Topsoil sodicity (SAR)	5–30
Subsoil texture	Silty clay loam to silty clay
Subsoil fragments	None
Subsoil pH	8.4–9.1
Subsoil salinity (EC)	2–16 dS/m
Subsoil sodicity (SAR)	5–30

Sources: NRCS (2020a, 2020d)

2.7.2 Vegetation

Potential vegetation growth form composition in Desert Flat (Shadscale) ecological sites is 10% grasses or grass-like plants, 5% forbs, and 85% woody plants (Table F-16; NRCS 2020a). The major grass species found at this site include Indian ricegrass and squirreltail. Other commonly occurring grasses include James' galleta and Sandberg bluegrass. Dominant woody species found at this ecological site include shadscale saltbush, trailing krameria (*Krameria lanceolata*), bud sagebrush, and green molly. Subdominant woody species include basin saltbush, yellow rabbitbrush, Nevada jointfir, greasewood, and shortspine horsebrush (NRCS 2020a).

TABLE F-16 VEGETATION CHARACTERISTICS TYPICAL OF DESERT FLAT (SHADSCALE) ECOLOGICAL SITES

Growth Form	Composition
Grasses	10%
Forbs	5%
Shrubs	85%

Source: NRCS (2020a)

2.8 Desert Gravelly Loam (Shadscale) Ecological Site Description

Desert Gravelly Loam (Shadscale) ecological sites in the TWE Project within the Fillmore FO occur on broad, nearly level hilltops, alluvial fans, fan remnants, terraces and lake terraces with slopes ranging from 0% to 15% (NRCS 2020a). The soils on this site were formed in alluvium derived mainly from sedimentary and quartzite parent materials. The soil series within this ecological site in the TWE Project boundary include Robido and Uver. Precipitation ranges between 5 to 12 inches annually in Desert Gravelly Loam (Shadscale) ecological sites (NRCS 2020a).

2.8.1 Soil Characteristics

Desert Gravelly Loam (Shadscale) ecological sites are well drained to somewhat excessively drained and have moderately rapid permeability (Table F-17; NRCS 2020a). Topsoil textures range from gravelly

sandy loam, gravelly fine sandy loam, to gravelly loam. Average topsoil depth is approximately 4.60 ± 1.74 inches. Subsoil textures range from sandy clay loam to gravelly loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-17).

TABLE F-17 SOIL CHARACTERISTICS TYPICAL OF DESERT GRAVELLY LOAM (SHADSCALE) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium underlain by coarser sediments deposited by waves of the ancient lake derived mainly from limestone and calcareous sandstone parent materials
Topsoil depth	4.60 ± 1.74 inches
Topsoil texture	Gravelly sandy loam, gravelly fine sandy loam, and gravelly loam
Topsoil fragments	0%–25% gravel
Topsoil pH	8.5–9.0
Topsoil salinity (EC)	0–4 dS/m
Topsoil sodicity (SAR)	0–60
Subsoil texture	Sandy clay loam to gravelly loam
Subsoil fragments	25% gravel
Subsoil pH	8.4–9.1
Subsoil salinity (EC)	0–4 dS/m
Subsoil sodicity (SAR)	0–60

Sources: NRCS (2020a, 2020d)

2.8.2 Vegetation

Potential vegetation growth form compositions Desert Gravelly Loam (Shadscale) is 40% grasses or grass-like plants, 10% forbs, and 50% woody plants (Table F-18; NRCS 2020a). The major grasses include creeping James' galleta (*Pleuraphis jamesii*), Indian ricegrass, and squirreltail. Dominant woody species include narrowleaf cottonwood (*Populus angustifolia*), skunkbush sumac, and basin big sagebrush. Subdominant woody species shadscale saltbush, Nevada jointfir (*Ephedra nevadensis*), Nuttall's horsebrush (*Tetradymia nuttallii*), bud sagebrush (*Picrothamnus desertorum*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*), and winterfat (*Krascheninnikovia lanata*) (NRCS 2020a).

TABLE F-18 VEGETATION CHARACTERISTICS TYPICAL OF DESERT GRAVELLY LOAM (SHADSCALE) ECOLOGICAL SITES

Growth Form	Composition
Grasses	40%
Forbs	10%
Shrubs	50%

Source: NRCS (2020a)

2.9 High Mountain Very Steep Loam (Engelmann spruce) Ecological Site Description

High Mountain Very Steep Stony Loam (Engelmann Spruce) ecological sites in the TWE Project within the Fillmore FO occur on mountainsides and moraines. Slopes are generally between 50% and 70% (NRCS 2020a). The soils on this site were formed in colluvium and glacial till from intrusive igneous

rocks. The soil series within this ecological site in the TWE Project boundary include Leighcan, Uinta, and Toze. Precipitation in High Mountain Very Steep Loam (Engelmann Spruce) ecological sites ranges from 20 to 40 inches annually (NRCS 2020a).

2.9.1 Soil Characteristics

Soils in High Mountain Very Steep Loam (Engelmann Spruce) ecological sites are well drained and moderately deep. Permeability is moderately slow to moderate and medium to rapid runoff potential (Table F-19; NRCS 2020a). Topsoil textures range from very stony sandy loam to gravelly silt loam. Average topsoil depth is approximately 10.00 ± 3.06 inches. Subsoil textures range from very stony sandy loam to gravelly silty clay (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-19).

TABLE F-19 SOIL CHARACTERISTICS TYPICAL OF VERY SHALLOW 7–9 INCH ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Colluvium and alluvium from sedimentary (sandstone, shale, and quartzite) and igneous rocks
Topsoil depth	10.00 ± 3.06
Topsoil texture	Very stony sandy loam to gravelly silt loam
Topsoil fragments	25% gravel, 15%–25% pebbles, 10% stones
Topsoil pH	5.3–7.6
Topsoil salinity (EC)	None
Topsoil sodicity (SAR)	None
Subsoil texture	Very stony sandy loam to gravelly silty clay
Subsoil fragments	20%–50% gravel, 15% cobbles, 0%–15% stones
Subsoil pH	5.6–9.2
Subsoil salinity (EC)	None
Subsoil sodicity (SAR)	None

Sources: NRCS (2020a, 2020d)

2.9.2 Vegetation

Potential vegetation growth form composition in High Mountain Very Steep Loam (Engelmann Spruce) ecological sites is 20% grasses or grass-like plants, 5% forbs, and 75% woody plants (Table F-20; NRCS 2020a). The major grass species found at this site include Wheeler bluegrass (*Poa nervosa*), thickspike wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*), prairie Junegrass, sheep fescue, Ross' sedge (*Carex rossii*), and Geyer's sedge. Dominant woody species found at this ecological site include dwarf bilberry (*Vaccinium cespitosum*), creeping barberry, common juniper (*Juniperus communis*), and gooseberry currant (*Ribes montigenum*) (NRCS 2020a). Engelmann spruce is the dominant pine species.

TABLE F-20 VEGETATION CHARACTERISTICS TYPICAL OF HIGH MOUNTAIN VERY STEEP LOAM (ENGELMAN SPRUCE) COLOGICAL SITES

Growth Form	Composition
Grasses	20%
Forbs	5%
Shrubs	75%

Source: NRCS (2020a)

2.10 Mountain Loam (Mountain Big Sagebrush) Ecological Site Description

Mountain Loam (Mountain Big Sagebrush) ecological sites in the TWE Project within the Fillmore FO are found on mountain slopes and fan remnants with slopes ranging from 2% to 60%. Runoff is medium to high depending on slope and plant basal cover (NRCS 2020a). The soils on this site were formed in sandstone, shale, limestone, quartzite, volcanic ash, and igneous rock. The soil series within this ecological site in the TWE Project boundary include Lodar and Manila. Precipitation in Mountain Loam (Mountain Big Sagebrush) ecological sites averages 21 inches annually (NRCS 2020a).

2.10.1 Soil Characteristics

Mountain Loam (Mountain Big Sagebrush) ecological sites are at least 60 inches deep, are well drained, and have moderately slow to moderate permeability (Table F-21; NRCS 2020a). Topsoil textures range from cobbly loam to silt loam. Average topsoil depth is approximately 7.0 ± 2.0 inches. Subsoil textures range from loam to clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-21).

TABLE F-21 SOIL CHARACTERISTICS TYPICAL OF MOUNTAIN LOAM (MOUNTAIN BIG SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in sandstone, shale, limestone, quartzite, volcanic ash, and igneous rock
Topsoil depth	7.0 ± 2.0 inches
Topsoil texture	Cobbly loam to silt loam
Topsoil fragments	50% cobbles
Topsoil pH	6.9–7.8
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Loam to clay loam
Subsoil fragments	50% pebbles
Subsoil pH	6.5–8.0
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.10.2 Vegetation

Potential vegetation growth form composition in Mountain Loam (Mountain Big Sagebrush) ecological sites is 80% grasses or grass-like plants, 5% forbs, and 15% woody plants (Table F-22; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass and basin wildrye. Other commonly occurring grasses include Indian ricegrass, Letterman's needlegrass (*Achnatherum lettermanii*), Columbia needlegrass (*Achnatherum nelsonii*), California brome (*Bromus carinatus*), Geyer's sedge (*Carex geyeri*), squirreltail, slender wheatgrass (*Elymus trachycaulus*), sheep fescue (*Festuca ovina*), needle and thread, prairie Junegrass, spike fescue (*Leucopoa kingii*), oniongrass (*Melica bulbosa*), western wheatgrass, and Sandberg bluegrass. Dominant woody species found at this ecological site include Utah juniper and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). Subdominant woody species include Saskatoon serviceberry (*Amelanchier alnifolia*), alderleaf mountain mahogany (*Cercocarpus montanus*), yellow rabbitbrush, slender buckwheat, broom snakeweed, creeping barberry

(*Mahonia repens*), antelope bitterbrush (*Purshia tridentata*), mountain snowberry (*Symphoricarpos oreophilus*), and spineless horsebrush (*Tetradymia canescens*) (NRCS 2020a).

TABLE F-22 VEGETATION CHARACTERISTICS TYPICAL OF MOUNTAIN LOAM (MOUNTAIN BIG SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	80%
Forbs	5%
Shrubs	15%

Source: NRCS (2020a)

2.11 Mountain Stony Loam (Antelope Bitterbrush) Ecological Site Description

Mountain Stony Loam (Antelope Bitterbrush) ecological sites in the TWE Project within the Fillmore FO occur on mountain slopes, ridges, and alluvial fans. It is found on all aspects with slopes ranging from 20% to 70%. Runoff is medium to high and flooding and ponding do not occur on the site (NRCS 2020a). The soils on this site were formed in alluvium, colluvium, and residuum derived from various sedimentary and igneous rocks. The soil series within this ecological site in the TWE Project boundary include Sheep Creek, Agassiz, Lodar, and Parkay. Precipitation in Mountain Stony Loam (Antelope Bitterbrush) ecological sites averages between 22 to 30 inches annually (NRCS 2020a).

2.11.1 Soil Characteristics

Mountain Stony Loam (Antelope Bitterbrush) ecological sites are well drained and moderately deep to deep. Permeability is moderate (Table F-23; NRCS 2020a). Topsoil textures range from very cobbly loam to very cobbly silt loam. Average topsoil depth is approximately 11.30 ± 4.99 inches. Subsoil textures range from very cobbly loam to very cobbly clay loam (NRCS 2020a). Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table F-23).

TABLE F-23 SOIL CHARACTERISTICS TYPICAL OF MOUNTAIN STONY LAOM (ANTELOPE BITTERBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in colluvium and residuum derived mainly from limestone and chert parent materials
Topsoil depth	11.30 ± 4.99 inches
Topsoil texture	Very cobbly loam to very cobbly silt loam
Topsoil fragments	15%–50% cobbles
Topsoil pH	7.0–7.8
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Very cobbly loam to very cobbly clay loam
Subsoil fragments	35%–70% cobbles, 50% pebbles, 10% gravel
Subsoil pH	7.1–8.0
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Source: NRCS (2020a, 2020d)

2.11.2 Vegetation

Potential vegetation growth form composition in Mountain Stony Loam (Antelope Bitterbrush) ecological sites is 50% grasses or grass-like plants, 10% forbs, and 40% woody plants (Table F-24; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass, Letterman's needlegrass, and slender wheatgrass. Other commonly occurring grasses include Geyer's sedge, squirreltail, sheep fescue, needle and thread, prairie Junegrass, basin wildrye, spike fescue, oniongrass, muttongrass (*Poa fendleriana*), and Sandberg bluegrass. Dominant woody species found at this ecological site include antelope bitterbrush, mountain big sagebrush, and alderleaf mountain mahogany. Subdominant woody species include Saskatoon serviceberry, feather fingergrass (*Chloris virgata*), creeping barberry, plains pricklypear, and mountain snowberry (NRCS 2020a).

TABLE F-24 VEGETATION CHARACTERISTICS TYPICAL OF MOUNTAIN STONY LOAM (ANTELOPE BITTERBRUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	50%
Forbs	10%
Shrubs	40%

Source: NRCS (2020a)

2.12 Mountain Stony Loam (Mountain Big Sagebrush) Ecological Site Description

Mountain Stony Loam (Mountain Big Sagebrush) ecological sites in the TWE Project within the MLSNF and UWCNF occur on mountain slopes, hills, swales, stream terraces, and terminal moraines on all aspects and on slopes ranging from 25% to 70% (NRCS 2020a). Major soil series associated with Mountain Stony Loam (Mountain Big Sagebrush) ecological sites include Ant Flat and Obrast. The climate in Mountain Stony Loam (Mountain Big Sagebrush) ecological sites is characterized by cold snowy winters and cool dry summers. Winter and spring precipitation, as snow and rainfall respectively, are the most reliable sources of available moisture to support vegetation growth. In Mountain Stony Loam (Mountain Big Sagebrush) ecological sites, limited available moisture during July and August is associated with high rates of evapotranspiration, which slows down vegetative growth (NRCS 2020a).

2.12.1 Soil Characteristics

Mountain Stony Loam (Mountain Big Sagebrush) ecological sites are characterized by moderately deep to deep soils that are well drained to somewhat excessively drained with moderately slow to moderate permeability and medium runoff potential (Table F-25; NRCS 2020a). Topsoil textures range from loam to silty loam and depth averages approximately 4.5 ± 5.0 inches. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-25).

TABLE F-25 SOIL CHARACTERISTICS TYPICAL OF MOUNTAIN STONY LOAM (MOUNTAIN BIG SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium, residuum, and colluvium from sandstone and shale sedimentary rock
Topsoil depth	4.5 ± 5.0 inches
Topsoil texture	Loam to silty loam
Topsoil fragments	5%–15% rock fragments

Soil Characteristics	Description
Topsoil pH	7.0
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Clay to silty clay loam
Subsoil fragments	0%–30% cobbles and shale
Subsoil pH	7.0–8.4
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.12.2 Vegetation

Vegetative structure (% cover) in Mountain Stony Loam (Mountain Big Sagebrush) ecological sites is dominated by grasses (Table F-26; NRCS 2020a). The dominant grasses that may occur in Mountain Stony Loam (Mountain Big Sagebrush) ecological sites include bluebunch wheatgrass, slender wheatgrass, Letterman's needlegrass, and (NRCS 2020a). Other grasses and grass-like plants may include Geyer's sedge, squirreltail, sheep fescue (*Festuca ovina*), needle and thread, prairie Junegrass, basin wildrye, spike fescue (*Leucopoa kingii*), oniongrass (*Melica bulbosa*), muttongrass, and Sandberg bluegrass (*Poa secunda*). Mountain big sagebrush is the major woody plant. Other woody plants that may occur include alderleaf mountain mahogany and antelope bitterbrush.

TABLE F-26 VEGETATION CHARACTERISTICS TYPICAL OF MOUNTAIN STONY LOAM (MOUNTAIN BIG SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Cover	Composition
Grasses	–	–
Forbs	–	–
Shrubs	–	–

Source: NRCS (2020a)

2.13 Semiwet Fresh Streambank (Narrowleaf Cottonwood) Ecological Site Description

Semiwet Fresh Streambank (Narrowleaf Cottonwood) ecological sites in the TWE Project within the Fillmore FO occur in floodplains. Slopes are mostly 0% to 4% (NRCS 2020a). The soils on this site were formed in alluvium derived mainly from sedimentary and quartzite parent materials. The soil series within this ecological site in the TWE Project boundary include Robido and Uver. Precipitation ranges between 5 to 12 inches annually in Semiwet Fresh Streambank (Narrowleaf Cottonwood) ecological sites (NRCS 2020a).

2.13.1 Soil Characteristics

Semiwet Fresh Streambank (Narrowleaf Cottonwood) ecological sites are very deep and very poorly drained soils (Table F-27; NRCS 2020a). Soils are occasionally flooded during high runoff and are affected by a fluctuating water table during parts of the plant growing season. Topsoil textures range from fine sandy loam to loam. Average topsoil depth is approximately 7.0 ± 2.0 inches. Subsoil textures range from sandy loam to extremely cobbly loamy sand (NRCS 2020a). Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table F-27).

TABLE F-27 SOIL CHARACTERISTICS TYPICAL OF SEMIWET FRESH STREAMBANK (NARROWLEAF COTTONWOOD) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium derived mainly from sedimentary and quartzite parent materials
Topsoil depth	7.0 ± 2.0 inches
Topsoil texture	Fine sandy loam to loam
Topsoil fragments	15%–35% rounded rocks, 5% gravel, 5% cobbles
Topsoil pH	8.0
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–5
Subsoil texture	Sandy loam to extremely cobbly loamy sand
Subsoil fragments	20% gravel, 45% cobbles, 10% stones
Subsoil pH	7.7–8.0
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0–5

Sources: NRCS (2020a, 2020d)

2.13.2 Vegetation

Potential vegetation growth form composition in Semiwet Fresh Streambank (Narrowleaf Cottonwood) ecological sites is 35% grasses or grass-like plants, 20% forbs, and 45% woody plants (Table F-28; NRCS 2020a). The major grasses include creeping bentgrass (*Agrostis stolonifera*) and sand dropseed. Other grasses and grass-like plants that may be found at this ecological site include clustered field sedge, saltgrass, slender wheatgrass, basin wildrye, mat muhly, and Kentucky bluegrass (*Poa pratensis*). Dominant woody species include narrowleaf cottonwood, skunkbush sumac, and basin big sagebrush. Subdominant woody species include Woods' rose, narrowleaf willow (*Salix exigua*), silver buffaloberry (*Shepherdia argentea*) (NRCS 2020a).

TABLE F-28 VEGETATION CHARACTERISTICS TYPICAL OF SEMIWET FRESH STREAMBANK (NARROWLEAF COTTONWOOD) ECOLOGICAL SITES

Growth Form	Composition
Grasses	35%
Forbs	20%
Shrubs	45%

Source: NRCS (2020a)

2.14 Semidesert Gravelly Loam (Wyoming Big Sagebrush) North Ecological Site Description

Semidesert Gravelly Loam (Wyoming Big Sagebrush) North ecological sites in the TWE Project within the Fillmore FO occur on fan terraces, fan remnants, and alluvial fans. The slope is typically between 2% and 15% (NRCS 2020a). The soils on this site were formed in mixed alluvium. The soil series within this ecological site in the TWE Project boundary include Donnardo, Hiko Peak, Linoyer, Truesdale, Uvada, and Skumpah. Precipitation in Semidesert Gravelly Loam (Wyoming Big Sagebrush) North ecological sites averages between 8 to 12 inches annually (NRCS 2020a).

2.14.1 Soil Characteristics

Semidesert Gravelly Loam (Wyoming Big Sagebrush) North ecological sites are usually deep, have moderate to moderately rapid permeability, and are moderately well drained to excessively drained (Table F-29; NRCS 2020a). Topsoil textures range from very stony loam to fine sandy loam. Average topsoil depth is approximately 7.3 ± 3.1 inches. Subsoil textures range from very gravelly loam to fine sandy loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-29).

TABLE F-29 SOIL CHARACTERISTICS TYPICAL OF VERY SEMIDESERT GRAVELLY LOAM (WYOMING BIG SAGEBRUSH) NORTH ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in mixed alluvium from sedimentary rocks
Topsoil depth	7.3 ± 3.1 inches
Topsoil texture	Very stony loam to fine sandy loam
Topsoil fragments	10%–25% cobbles, 10% gravel
Topsoil pH	7.4–8.4
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–13
Subsoil texture	Very gravelly loam to fine sandy loam
Subsoil fragments	70% cobble, 35% gravel
Subsoil pH	7.8–8.6
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0–13

Sources: NRCS (2020a, 2020d)

2.14.2 Vegetation

Potential vegetation growth form composition in Semidesert Gravelly Loam (Wyoming Big Sagebrush) North ecological sites is 60% grasses or grass-like plants, 25% forbs, and 15% woody plants (Table F-30; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass, Indian ricegrass, and slender wheatgrass. Other commonly occurring grasses include needle and thread, western wheatgrass, Sandberg bluegrass, and sand dropseed. Dominant woody species found at this ecological site include Wyoming big sagebrush, shadscale saltbush, and yellow rabbitbrush. Subdominant woody species include black sagebrush, spiny hopsage, broom snakeweed, winterfat, plains pricklypear, bud sagebrush and Nuttall's horsebrush (NRCS 2020a).

TABLE F-30 VEGETATION CHARACTERISTICS TYPICAL OF SEMIDESERT GRAVELLY LOAM (WYOMING BIG SAGEBRUSH) NORTH ECOLOGICAL SITES

Growth Form	Composition
Grasses	60%
Forbs	25%
Shrubs	15%

Source: NRCS (2020a)

2.15 Semidesert Loam (Wyoming Big Sagebrush) Ecological Site Description

Semidesert Loam (Wyoming Big Sagebrush) ecological sites in the TWE Project within the Fillmore FO occur on lake terraces, floodplains, alluvial flats, and fan remnants. This site occurs on slopes between 0% and 8% (NRCS 2020a). The soils on this site were formed in alluvium and lacustrine sediments derived from sedimentary rocks. The soil series within this ecological site in the TWE Project boundary include Truesdale and Woodrow soil series. The climate is cold and snowy in the winter and warm and dry in the summer. Precipitation in Semidesert Loam (Wyoming Big Sagebrush) ecological sites averages between 9 to 15 inches annually (NRCS 2020a).

2.15.1 Soil Characteristics

Semidesert Loam (Wyoming Big Sagebrush) ecological sites are characteristically more than 60 inches deep and well drained. The permeability of these soils is slow to moderately. Runoff potential ranges from low to medium (Table F-31; NRCS 2020a). Topsoil textures range from fine sandy loam to silty clay loam. Average topsoil depth is approximately 3.0 ± 0.0 inches. Subsoil textures range from fine sandy loam to silty clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-31).

TABLE F-31 SOIL CHARACTERISTICS TYPICAL OF SEMIDESERT LOAM (WYOMING BIG SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium and lacustrine sediments derived from sedimentary rocks
Topsoil depth	3.0 ± 0.0 inches
Topsoil texture	Fine sandy loam to silty clay loam
Topsoil fragments	None
Topsoil pH	7.4–8.3
Topsoil salinity (EC)	0–4 dS/m
Topsoil sodicity (SAR)	0–10
Subsoil texture	Fine sandy loam to silty clay loam
Subsoil fragments	None
Subsoil pH	7.8–8.4
Subsoil salinity (EC)	0–4 dS/m
Subsoil sodicity (SAR)	0–10

Sources: NRCS (2020a, 2020d)

2.15.2 Vegetation

Potential vegetation growth form composition in Semidesert Loam (Wyoming Big Sagebrush) ecological sites is 45% grasses or grass-like plants, 10% forbs, and 45% woody plants (Table F-32; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass and Indian ricegrass. Other grasses and grass-like plants found at this site include purple threeawn, blue grama, squirreltail, needle and thread, basin wildrye, western wheatgrass, James' galleta, muttongrass, and Sandberg bluegrass.

Dominant woody species found at this ecological site include Wyoming big sagebrush, yellow rabbitbrush, and Nevada jointfir. Subdominant woody species include shadscale saltbush, winterfat, bud sagebrush, spineless horsebrush, shortspine horsebrush, plains pricklypear, slender buckwheat, rubber

rabbitbrush, spiny hopsage, broom snakeweed, black sagebrush, basin big sagebrush, and fourwing saltbush (NRCS 2020a).

TABLE F-32 VEGETATION CHARACTERISTICS TYPICAL OF SEMIDESERT LOAM (WYOMING BIG SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	45%
Forbs	10%
Shrubs	45%

Source: NRCS (2020a)

2.16 Semidesert Shallow Hardpan (Black Sagebrush) Ecological Site Description

Semidesert Shallow Hardpan (Black Sagebrush) ecological sites in the TWE Project within the Fillmore FO occur on alluvial fans and fan remnants. Slopes are generally between 2% and 15% (NRCS 2020a). The soils on this site were formed in alluvium derived from limestone, sandstone, and/or igneous rock. The soil series within this ecological site in the TWE Project boundary include Borvant, Truesdale, and Plegomir. Precipitation in Semidesert Shallow Hardpan (Black Sagebrush) ecological sites averages between 9 to 13 inches annually (NRCS 2020a).

2.16.1 Soil Characteristics

Semidesert Shallow Hardpan (Black Sagebrush) ecological sites are well drained to somewhat excessively drained. The permeability of these soils is moderately slow to moderately rapid (Table F-33; NRCS 2020a). Topsoil textures range from gravelly loam to fine sandy loam. Average topsoil depth is approximately 5.00 ± 2.31 inches. Subsoil textures range from extremely gravelly to sandy clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-33).

TABLE F-33 SOIL CHARACTERISTICS TYPICAL OF SEMIDESERT SHALLOW HARDPAN (BLACK SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in colluvium and residuum derived mainly from limestone, sandstone, siltstone, and basalt parent materials
Topsoil depth	5.00 ± 2.31 inches
Topsoil texture	Gravelly loam to fine sandy loam
Topsoil fragments	25% gravel, 3% cobbles
Topsoil pH	7.9–8.1
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–13
Subsoil texture	Extremely gravelly to sandy clay loam
Subsoil fragments	75% gravel
Subsoil pH	8.0–8.3
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0–13

Sources: NRCS (2020a, 2020d)

2.16.2 Vegetation

Potential vegetation growth form composition in Semidesert Shallow Hardpan (Black Sagebrush) ecological sites is 45% grasses or grass-like plants, 10% forbs, and 45% woody plants (Table F-34; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass, Indian ricegrass, squirreltail, and needle and thread. Other commonly occurring grasses include sand dropseed, western wheatgrass, James' galleta, Sandberg bluegrass, blue grama, and purple threeawn. Dominant woody species found at this ecological site include black sagebrush and yellow rabbitbrush. Subdominant woody species include spiny phlox (*Phlox hoodii*), shadscale saltbush, winterfat, plains pricklypear, Nevada jointfir, mormon tea, bud sagebrush, Nuttall's horsebrush, broom snakeweed, shortspine horsebrush, rubber rabbitbrush, spiny hopsage, and fourwing saltbush (NRCS 2020a).

TABLE F-34 VEGETATION CHARACTERISTICS TYPICAL OF SEMIDESERT SHALLOW HARDPAN (BLACK SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	45%
Forbs	10%
Shrubs	45%

Source: NRCS (2020a)

2.17 Semidesert Shallow Loam (Black Sagebrush) Ecological Site Description

Semidesert Shallow Loam (Black Sagebrush) ecological sites in the TWE Project within the Fillmore FO occur on hillsides, mountains, and to a lesser extent on pediments. Slopes are generally between 5% and 45% (NRCS 2020a). The soils on this site were formed in colluvium and residuum derived mainly from limestone, sandstone, siltstone, and basalt parent materials. The soil series within this ecological site in the TWE Project boundary include Checkett and Donnardo. Precipitation in Semidesert Shallow Loam (Black Sagebrush) ecological sites averages between 8 to 12 inches annually (NRCS 2020a).

2.17.1 Soil characteristics

Semidesert Shallow Loam (Black Sagebrush) ecological sites are 10 to 20 inches deep over bedrock and well drained. The permeability of these soils is moderate (Table F-35; NRCS 2020a). Topsoil textures range from very cobbly loam to very cobbly loam. Average topsoil depth is approximately 8.0 ± 4.0 inches. Subsoil textures range from very cobbly loam to very cobbly clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-35).

TABLE F-35 SOIL CHARACTERISTICS TYPICAL OF SEMIDESERT SHALLOW LOAM (BLACK SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in colluvium and residuum derived mainly from limestone, sandstone, siltstone, and basalt parent materials
Topsoil depth	8.0 ± 4.0 inches
Topsoil texture	Very cobbly loam to very cobbly clay loam
Topsoil fragments	3% stones, 23% cobbles, 20% gravel
Topsoil pH	7.4–8.4

Soil Characteristics	Description
Topsoil salinity (EC)	–
Topsoil sodicity (SAR)	–
Subsoil texture	Very cobbly loam to very cobbly clay loam
Subsoil fragments	50%–60% cobbles
Subsoil pH	8.2–8.6
Subsoil salinity (EC)	–
Subsoil sodicity (SAR)	–

Sources: NRCS (2020a, 2020d)

2.17.2 Vegetation

Potential vegetation growth form composition in Semidesert Shallow Loam (Black Sagebrush) ecological sites is 45% grasses or grass-like plants, 5% forbs, and 50% woody plants (Table F-36; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass, Indian ricegrass, and needle and thread. Other commonly occurring grasses include purple threeawn, squirreltail, James' galleta, and Sandberg bluegrass. The dominant woody species found at this ecological site is black sagebrush. Subdominant woody species include shadscale saltbush, yellow rabbitbrush, Nevada jointfir, broom snakeweed, winterfat, granite prickly phlox, plains pricklypear, bud sagebrush, Mexican cliffrose, stemless mock goldenweed (*Stenotus acaulis*), and Nuttall's horsebrush (NRCS 2020a).

TABLE F-36 VEGETATION CHARACTERISTICS TYPICAL OF SEMIDESERT SHALLOW LOAM (BLACK SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	45%
Forbs	5%
Shrubs	50%

Source: NRCS (2020a)

2.18 Semidesert Very Shallow Loam (Little Leaf Mountain Mahogany) Ecological Site Description

Semidesert Very Shallow Loam (Little Leaf Mountain Mahogany) ecological sites in the TWE Project within the Fillmore FO occur on rolling hills and steep mountain slopes. Slopes are generally between 15% and 70% (NRCS 2020a). The soils on this site were formed in colluvium derived mainly from limestone parent materials. The soil series within this ecological site in the TWE Project boundary include Agassiz, Flygare, Amtoft, and Sheep Creek. Precipitation in Semidesert Very Shallow Loam (Little Leaf Mountain Mahogany) ecological sites averages between 8 to 12 inches annually (NRCS 2020a).

2.18.1 Soil Characteristics

Semidesert Very Shallow Loam (Little Leaf Mountain Mahogany) ecological sites are 6 to 14 inches deep over bedrock and well drained (Table F-37; NRCS 2020a). Topsoil textures range from very cobbly silt loam to flaggy loam. Average topsoil depth is approximately 8.00 ± 1.63 inches. Subsoil textures range from very cobbly silt clay loam to flaggy loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-37).

TABLE F-37 SOIL CHARACTERISTICS TYPICAL OF SEMIDESERT VERY SHALLOW LOAM (LITTLE LEAF MOUNTAIN MAHOGANY) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in colluvium derived mainly from limestone parent materials
Topsoil depth	8.00 ± 1.63 inches
Topsoil texture	Very cobbly silt loam to flaggy loam
Topsoil fragments	20%–60% cobbles
Topsoil pH	6.4–8.4
Topsoil salinity (EC)	0–4 dS/m
Topsoil sodicity (SAR)	–
Subsoil texture	Very cobbly silt clay loam to flaggy loam
Subsoil fragments	60% cobbles, 35%–70% gravel
Subsoil pH	5.1–8.8
Subsoil salinity (EC)	0–4 dS/m
Subsoil sodicity (SAR)	–

Sources: NRCS (2020a, 2020d)

2.18.2 Vegetation

Potential vegetation growth form composition in Semidesert Very Shallow Loam (Little Leaf Mountain Mahogany) ecological sites is 25% grasses or grass-like plants, 10% forbs, and 65% woody plants (Table F-38; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass, Indian ricegrass, and Sandberg bluegrass. Other commonly occurring grasses include pine needlegrass (*Achnatherum pinetorum*), squirreltail, and needle and thread. Dominant woody species found at this ecological site include littleleaf mountain mahogany (*Cercocarpus intricatus*), black sagebrush, shadscale saltbush, and yellow rabbitbrush (NRCS 2020a).

TABLE F-38 VEGETATION CHARACTERISTICS TYPICAL OF SEMIDESERT VERY SHALLOW LOAM (LITTLE LEAF MOUNTAIN MAHOGANY) ECOLOGICAL SITES

Growth Form	Composition
Grasses	25%
Forbs	10%
Shrubs	65%

Source: NRCS (2020a)

2.19 Upland Shallow Hardpan (Pinyon–Utah Juniper) Ecological Site Description

Upland Shallow Hardpan (Pinyon–Utah Juniper) ecological sites in the TWE Project within the Fillmore FO occur most commonly on alluvial fans and fan remnants, and occasionally on mountain slopes. Slopes are gentle ranging from 2% to 25% (NRCS 2020a). The soils on this site were formed in alluvium derived mainly from limestone, sandstone, or igneous parent materials. The soil series within this ecological site in the TWE Project boundary include Revor, Elenore, and Borvant soil series. The climate is cold and snowy in the winter and warm and dry in the summer. Precipitation in Upland Shallow Hardpan (Pinyon–Utah Juniper) ecological sites averages between 13 to 18 inches annually but in a few instances is as high as 20 inches on south and west exposures (NRCS 2020a).

2.19.1 Soil Characteristics

Upland Shallow Hardpan (Pinyon–Utah Juniper) ecological sites are shallow and well drained. The permeability of these soils is moderate. Runoff potential ranges from medium to high (Table F-39; NRCS 2020a). Topsoil textures are characterized as gravelly loam. Average topsoil depth is approximately 7.30 ± 0.67 inches. Subsoil textures range from very gravelly loam to gravelly sandy clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-39).

TABLE F-39 SOIL CHARACTERISTICS TYPICAL OF UPLAND SHALLOW HARDPAN (PINYON–UTAH JUNIPER) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium derived mainly from limestone, sandstone, or igneous parent materials
Topsoil depth	7.30 ± 0.67 inches
Topsoil texture	Gravelly loam
Topsoil fragments	10%–65% gravel, 5%–30% cobbles
Topsoil pH	7.2–8.1
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Very gravelly loam to gravelly sandy clay loam
Subsoil fragments	35%–60% gravel
Subsoil pH	7.8–8.2
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.19.2 Vegetation

Potential vegetation growth form composition in Upland Shallow Hardpan (Pinyon–Utah Juniper) ecological sites is 40% grasses or grass-like plants, 10% forbs, and 50% woody plants (Table F-40; NRCS 2020a). The major grass species found at this site include Indian ricegrass, bluebunch wheatgrass, squirreltail, and needle and thread. Other grasses and grass-like plants found at this site include prairie Junegrass, western wheatgrass, Sandberg bluegrass, and sand dropseed. Dominant woody species found at this ecological site include singleleaf pinyon, Utah juniper, black sagebrush, Wyoming big sagebrush, Mexican cliffrose, and antelope bitterbrush. Subdominant woody species include yellow rabbitbrush, Nevada jointfir, broom snakeweed, stemless mock goldenweed, mountain snowberry, and shadscale saltbush (NRCS 2020a).

TABLE F-40 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND SHALLOW HARDPAN (PINYON–UTAH JUNIPER) ECOLOGICAL SITES

Growth Form	Composition
Grasses	40%
Forbs	10%
Shrubs	50%

Source: NRCS (2020a)

2.20 Upland Shallow Loam (Black Sagebrush) Ecological Site Description

Upland Shallow Loam (Black Sagebrush) ecological sites in the TWE Project within the Fillmore FO occur on rolling hills and steep mountain slopes. Slopes are generally between 15% and 70% (NRCS 2020a). The soils on this site were formed in colluvium derived mainly from limestone parent materials. The soil series within this ecological site in the TWE Project boundary include Lodar, Pibler, and Saxby. Precipitation in Upland Shallow Loam (Black Sagebrush) ecological sites averages between 12 to 18 inches annually (NRCS 2020a).

2.20.1 Soil Characteristics

Upland Shallow Loam (Black Sagebrush) ecological sites are 6 to 14 inches deep over bedrock and well drained (Table F-41; NRCS 2020a). Topsoil textures range from very cobbly loam to gravelly fine sandy loam. Average topsoil depth is approximately 6.70 ± 2.67 inches. Subsoil textures range from very gravelly loam to extremely cobbly silt loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-41).

TABLE F-41 SOIL CHARACTERISTICS TYPICAL OF UPLAND SHALLOW LOAM (BLACK SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in colluvium derived from sedimentary rocks
Topsoil depth	6.70 ± 2.67 inches
Topsoil texture	Very cobbly loam to gravelly fine sandy loam
Topsoil fragments	50% cobbles, 25%–35% gravel, 40% stones
Topsoil pH	7.8–9.0
Topsoil salinity (EC)	0–4 dS/m
Topsoil sodicity (SAR)	–
Subsoil texture	Very gravelly loam to extremely cobbly silt loam
Subsoil fragments	50% pebbles, 30% cobbles, 35%–70% gravel
Subsoil pH	8.0–8.8
Subsoil salinity (EC)	0–4 dS/m
Subsoil sodicity (SAR)	–

Sources: NRCS (2020a, 2020d)

2.20.2 Vegetation

Potential vegetation growth form composition in Upland Shallow Loam (Black Sagebrush) ecological sites is 45% grasses or grass-like plants, 10% forbs, and 45% woody plants (Table F-42; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass, Indian ricegrass, blue grama, squirreltail, thickspike wheatgrass, needle and thread, prairie Junegrass, Salina wildrye (*Leymus salinus*), western wheatgrass, James' galleta, muttongrass, and Sandberg bluegrass. Dominant woody species found at this ecological site include black sagebrush, shadscale saltbush, spineless horsebrush, and shortspine horsebrush. Subdominant woody species found at this ecological site include winterfat, antelope bitterbrush, shadscale saltbush, curl-leaf mountain mahogany, alderleaf mountain mahogany, yellow rabbitbrush, Nevada jointfir, rubber rabbitbrush, spiny hopsage, broom snakeweed, skunkbush sumac, Nuttall's horsebrush, and plains pricklypear (NRCS 2020a).

TABLE F-42 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND SHALLOW LOAM (BLACK SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	45%
Forbs	10%
Shrubs	45%

Source: NRCS (2020a)

2.21 Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) Ecological Site Description

Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) ecological sites in the TWE Project within the Fillmore FO occur on mountain slopes, lake terraces, and escarpments. The site is found on slopes ranging from 20% to 70%, occurs on all aspects, and produces medium to high amounts of runoff (NRCS 2020a). The soils on this site were formed in colluvium and residuum derived mainly from limestone and chert parent materials. The soil series within this ecological site in the TWE Project boundary include Pass Canyon, Richmond, and Amtoft. Precipitation in Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) ecological sites averages between 11 to 16 inches annually (NRCS 2020a).

2.21.1 Soil Characteristics

Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) ecological sites are shallow with bedrock typically within 20 inches of the soil surface. Soils are moderately slow to moderately rapidly permeable and are well drained to somewhat excessively drained (Table F-43; NRCS 2020a). Topsoil textures range from very cobbly coarse sandy loam to flaggy loam. Average topsoil depth is approximately 6.30 ± 3.33 inches. Subsoil textures are characterized as loamy (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-43).

TABLE F-43 SOIL CHARACTERISTICS TYPICAL OF VERY UPLAND SHALLOW LOAM (UTAH JUNIPER–SINGLE LEAF PINYON) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in colluvium and residuum derived mainly from limestone and chert parent materials
Topsoil depth	6.30 ± 3.33 inches
Topsoil texture	Very cobbly coarse sandy loam to flaggy loam
Topsoil fragments	3% stones, 25% cobbles, 10% gravel
Topsoil pH	7.6–8.4
Topsoil salinity (EC)	0–4 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Sandy clay loam to flaggy loam
Subsoil fragments	2%–15% cobbles, 10% gravel, 25% flaggy rock fragments
Subsoil pH	7.4–8.8
Subsoil salinity (EC)	0–4 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.21.2 Vegetation

Potential vegetation growth form composition in Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) ecological sites is 40% grasses or grass-like plants, 10% forbs, and 50% woody plants (Table F-44; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass, Indian ricegrass, and squirreltail. Other commonly occurring grasses include blue grama, Geyer’s sedge, squirreltail, needle and thread, prairie Junegrass, Salina wildrye, western wheatgrass, James’ galleta, muttongrass, Sandberg bluegrass, and sand dropseed.

Dominant woody species found at this ecological site include Utah juniper, twoneedle pinyon (*Pinus edulis*), singleleaf pinyon, black sagebrush, alderleaf mountain mahogany, and antelope bitterbrush. Subdominant woody species include Utah serviceberry, desert ceanothus (*Ceanothus greggii*), littleleaf mountain mahogany, curl-leaf mountain mahogany, yellow rabbitbrush, Nevada jointfir, slender buckwheat, broom snakeweed, plains pricklypear, Mexican cliffrose, and mountain snowberry (NRCS 2020a).

TABLE F-44 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND SHALLOW LOAM (UTAH JUNIPER – SINGLE LEAF PINYON) ECOLOGICAL SITES

Growth Form	Composition
Grasses	40%
Forbs	10%
Shrubs	50%

Source: NRCS (2020a)

2.22 Upland Stony Loam (Pinyon–Utah Juniper) Ecological Site Description

Upland Stony Loam (Pinyon–Utah Juniper) ecological sites in the TWE Project within the Fillmore FO are found on many landforms with deep stony soils, including mountain slopes, slump blocks, structural benches, remnant alluvial fans, remnant stream terraces, landslides, and benches. Slopes typically range between 2% and 50% (NRCS 2020a). The soils on this site were formed in alluvium or colluvium derived from diorite or sedimentary rock, including sandstone, siltstone, limestone, and shale. The soil series within this ecological site in the TWE Project boundary include Donnardo, Doyce, Firmage, Tacan, and Juab. The climate is cold and snowy in the winter and warm and dry in the summer. Precipitation in Upland Stony Loam (Pinyon–Utah Juniper) ecological sites averages between 12 to 16 inches annually (NRCS 2020a).

2.22.1 Soil Characteristics

Upland Stony Loam (Pinyon–Utah Juniper) ecological sites are deep and well drained. The permeability of these soils is moderate (Table F-45; NRCS 2020a). Topsoil textures range from very stony loam to very stony sandy loam. Average topsoil depth is approximately 8.80 ± 0.98 inches. Subsoil textures range from gravelly fine sand clay loam to stony loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-45).

TABLE F-45 SOIL CHARACTERISTICS TYPICAL OF UPLAND STONY LOAM (PINYON-UTAH JUNIPER) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium or colluvium derived from diorite or sedimentary rock, including sandstone, siltstone, limestone, and shale
Topsoil depth	8.80 ± 0.98 inches
Topsoil texture	Very stony loam to very stony sandy loam
Topsoil fragments	50% stones, 15%–35% pebbles, 40%–70% gravel
Topsoil pH	7.4–8.6
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Gravelly fine sand clay loam to stony loam
Subsoil fragments	50%–60% stones, 10%–35% gravel
Subsoil pH	7.8–8.8
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.22.2 Vegetation

Potential vegetation growth form composition in Upland Stony Loam (Pinyon–Utah Juniper) ecological sites is 20% grasses or grass-like plants, 5% forbs, and 75% woody plants (Table F-46; NRCS 2020a). The major grass species found at this site include blue grama and Indian ricegrass. Other grasses and grass-like plants found at this site include needle and thread, James' galleta, Geyer's sedge, muttongrass, Salina wildrye, prairie Junegrass, and squirreltail. Dominant woody species found at this ecological site include twoneedle pinyon and Utah juniper. Subdominant woody species include Gambel oak, Utah serviceberry, alderleaf mountain mahogany, broom snakeweed, mountain big sagebrush, greenleaf manzanita (*Arctostaphylos patula*), brittle pricklypear (*Opuntia fragilis*), mountain snowberry, roundleaf buffaloberry (*Shepherdia rotundifolia*), Spanish bayonet (*Yucca harrimaniae*), plains pricklypear, wild crab apple (*Peraphyllum ramosissimum*), kingcup cactus (*Echinocereus triglochidiatus*), and mormon tea (NRCS 2020a).

TABLE F-46 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND STONY LOAM (PINYON-UTAH JUNIPER) ECOLOGICAL SITES

Growth Form	Composition
Grasses	20%
Forbs	5%
Shrubs	75%

Source: NRCS (2020a)

2.23 Upland Stony Loam (Utah Juniper) Ecological Site Description

Upland Stony Loam (Utah Juniper) ecological sites in the TWE Project within the Fillmore FO are found on dissected alluvial fan landforms. Slopes typically range between 5% and 35%. (NRCS 2020a).

The soils on this site were formed in alluvium derived dominantly from mixed igneous and sedimentary rocks. The soil series within this ecological site in the TWE Project boundary include Donnardo, Lizzant,

and Sheep Creek. The climate is cold and snowy in the winter and warm and dry in the summer. Precipitation in Upland Stony Loam (Utah Juniper) ecological sites averages 14 inches annually (NRCS 2020a).

2.23.1 Soil Characteristics

Upland Stony Loam (Utah Juniper) ecological sites are deep and well drained. The permeability of these soils is moderately rapid (Table F-47; NRCS 2020a). Topsoil textures include cobbly loam. Average topsoil depth is approximately 9.3 ± 2.4 inches. Subsoil textures are characterized as very stony loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-47).

TABLE F-47 SOIL CHARACTERISTICS TYPICAL OF UPLAND STONY LOAM (UTAH JUNIPER) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium derived dominantly from mixed igneous and sedimentary rocks
Topsoil depth	9.3 ± 2.4 inches
Topsoil texture	Cobbly loam
Topsoil fragments	15%–50% cobbles, 35% gravel
Topsoil pH	7.0–8.4
Topsoil salinity (EC)	–
Topsoil sodicity (SAR)	–
Subsoil texture	Very stony loam
Subsoil fragments	50% cobbles, 35%–70% gravel
Subsoil pH	7.1–8.6
Subsoil salinity (EC)	–
Subsoil sodicity (SAR)	–

Sources: NRCS (2020a, 2020d)

2.23.2 Vegetation

Potential vegetation growth form composition in Upland Stony Loam (Utah Juniper) ecological sites is 50% grasses or grass-like plants, 10% forbs, and 40% woody plants (Table F-48; NRCS 2020a). The major grass species found at this site include Indian ricegrass, blue grama, squirreltail, and needle and thread. Other grasses and grass-like plants found at this site include Ross' sedge, western wheatgrass, Sandberg bluegrass, bluebunch wheatgrass, and sand dropseed. Dominant woody species found at this ecological site include Utah juniper, twoneedle pinyon, Rocky Mountain juniper (*Juniperus scopulorum*), mountain big sagebrush, antelope bitterbrush, and black sagebrush. Subdominant woody species include yellow rabbitbrush, mormon tea, broom snakeweed, Mexican cliffrose, and mountain snowberry (NRCS 2020a).

TABLE F-48 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND STONY LOAM (UTAH JUNIPER) ECOLOGICAL SITES

Growth Form	Composition
Grasses	50%
Forbs	10%

Growth Form	Composition
Shrubs	40%

Source: NRCS (2020a)

2.24 Upland Stony Loam (Wyoming Big Sagebrush) Ecological Site Description

Upland Stony Loam (Wyoming Big Sagebrush) ecological sites in the TWE Project within the Fillmore FO occur on alluvial fans, mountain slopes, lake terraces, fan remnants, and escarpments. Slopes typically range between 2% and 50%. (NRCS 2020a). The soils on this site were formed in alluvium derived dominantly from mixed igneous and sedimentary rocks. The soil series within this ecological site in the TWE Project boundary include Borvant, Reywat, Donnardo, Hansel, Juab, and Sumine. The climate is cold and snowy in the winter and warm and dry in the summer. Precipitation in Upland Stony Loam (Wyoming Big Sagebrush) ecological sites averages 14 inches annually (NRCS 2020a).

2.24.1 Soil Characteristics

Upland Stony Loam (Wyoming Big Sagebrush) ecological sites are characteristically greater than 20 inches deep and well drained to excessively well drained. The permeability of these soils is moderately slow to moderately rapid (Table F-49; NRCS 2020a). Runoff is low to medium. Topsoil textures range from gravelly loam to silt loam. Average topsoil depth is approximately 8.00 ± 1.46 inches. Subsoil textures range from gravelly sandy clay loam to silty clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table F-49).

TABLE F-49 SOIL CHARACTERISTICS TYPICAL OF VERY UPLAND STONY LOAM (WYOMING BIG SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium derived dominantly from mixed igneous and sedimentary rocks
Topsoil depth	8.00 ± 1.46 inches
Topsoil texture	Gravelly loam to silt loam
Topsoil fragments	30% gravel, 20% cobble, 3% stones
Topsoil pH	6.6–8.6
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–5
Subsoil texture	Gravelly sandy clay loam to gravelly clay loam
Subsoil fragments	30%–40% gravel
Subsoil pH	6.6–9.0
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0–5

Sources: NRCS (2020a, 2020d)

2.24.2 Vegetation

Potential vegetation growth form composition in Upland Stony Loam (Wyoming Big Sagebrush) ecological sites is 50% grasses or grass-like plants, 10% forbs, and 40% woody plants (Table F-50; NRCS 2020a). The major grass species found at this site include bluebunch wheatgrass, Indian ricegrass, squirreltail, prairie Junegrass, and muttongrass. Other grasses and grass-like plants found at this site

include needle and thread, western wheatgrass, James' galleta, and Sandberg bluegrass. Dominant woody species found at this ecological site include Wyoming big sagebrush and antelope bitterbrush. Subdominant woody species include Utah serviceberry, black sagebrush, alderleaf mountain mahogany, yellow rabbitbrush, Nevada jointfir, slender buckwheat, and broom snakeweed (NRCS 2020a).

TABLE F-50 VEGETATION CHARACTERISTICS TYPICAL OF UPLAND STONY LOAM (WYOMING BIG SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	50%
Forbs	10%
Shrubs	40%

Source: NRCS (2020a)

ATTACHMENT F-1

Fillmore Field Office Photographs



Figure F-1-1 **Representative Alkali Bottom (Alkali Sacaton) in the Fillmore FO. Site ID 1208ED03.**



Figure F-1-2 **Representative Alkali Flat (Black Greasewood) in the Fillmore FO.
Site ID 0422AK03.**



Figure F-1-3 Representative Desert Alkali Bench (Bud Sagebrush) in the Fillmore FO.
Site ID 0417AK02.



Figure F-1-4 Representative Desert Alkali Sand (Fourwing Saltbush) in the Fillmore FO.
Site ID 0419AK02.



Figure F-1-5 Representative Desert Flat (Shadscale) in the Fillmore FO. Site ID 0417AK06.



**Figure F-1-6 Representative Desert Gravelly Loam (Shadscale) in the Fillmore FO.
Site ID 1213ED12.**



**Figure F-1-7 Representative Desert Salt Flat (Sickle Saltbush) in the Fillmore FO.
Site ID 0419AK04.**



**Figure F-1-8 Representative Desert Shallow Loam (Shadscale) in the Fillmore FO.
Site ID 1206EC04.**



Figure F-1-9 Representative Desert Silt Loam (Winterfat) in the Fillmore FO. Site ID 1211EC08.



Figure F-1-10 Representative High Mountain Very Steep Loam (Engelmann Spruce) in the Fillmore FO. Site ID 0715RD02.



**Figure F-1-11 Representative Mountain Loam (Mountain Big Sagebrush) in the Fillmore FO.
Site ID 0711RC04.**



**Figure F-1-12 Representative Mountain Stony Loam (Antelope Bitterbrush) in the Fillmore FO.
Site ID 0710RC01.**



Figure F-1-13 Representative Mountain Stony Loam (Mountain Big Sagebrush) in the Fillmore FO. Site ID 0710RC02.



Figure F-1-14 Representative Semidesert Gravelly Loam (Wyoming Big Sagebrush) North in the Fillmore FO. Site ID 0504AF02.



**Figure F-1-15 Representative Semidesert Loam (Wyoming Big Sagebrush) in the Fillmore FO.
Site ID 0420AK16.**



**Figure F-1-16 Representative Semidesert Shallow Hardpan (Black Sagebrush) in the Fillmore FO.
Site ID 1212EC05.**



**Figure F-1-17 Representative Semidesert Shallow Loam (Black Sagebrush) in the Fillmore FO.
Site ID 1212EC05.**



**Figure F-1-18 Representative Semidesert Very Shallow Loam (Littleleaf Mountain Mahogany) in
the Fillmore FO. Site ID 0716SF01.**



Figure F-1-19 Representative Semiwet Fresh Streambank (Narrowleaf Cottonwood) in the Fillmore FO. Site ID 0419SF06.



Figure F-1-20 Representative Upland Loam (Bonneville Big Sagebrush) North in the Fillmore FO. Site ID 0421AK06.



**Figure F-1-21 Representative Upland Shallow Hardpan (Pinyon-Utah Juniper) in the Fillmore FO.
Site ID 0420SF09.**



**Figure F-1-22 Representative Upland Shallow Loam (Black Sagebrush) in the Fillmore FO.
Site ID 0420SF07.**



Figure F-1-23 Representative Upland Shallow Loam (Utah Juniper–Singleleaf Pinyon) in the Fillmore FO. Site ID 0709RC02.



Figure F-1-24 Representative Upland Stony Loam (Pinyon–Utah Juniper) in the Fillmore FO. Site ID 0420AK28.



**Figure F-1-25 Representative Upland Stony Loam (Utah Juniper) in the Fillmore FO.
Site ID 0709RC09.**



**Figure F-1-26 Representative Upland Shallow Hardpan (Pinyon-Utah Juniper) in the Fillmore FO.
Site ID 0423MW18.**

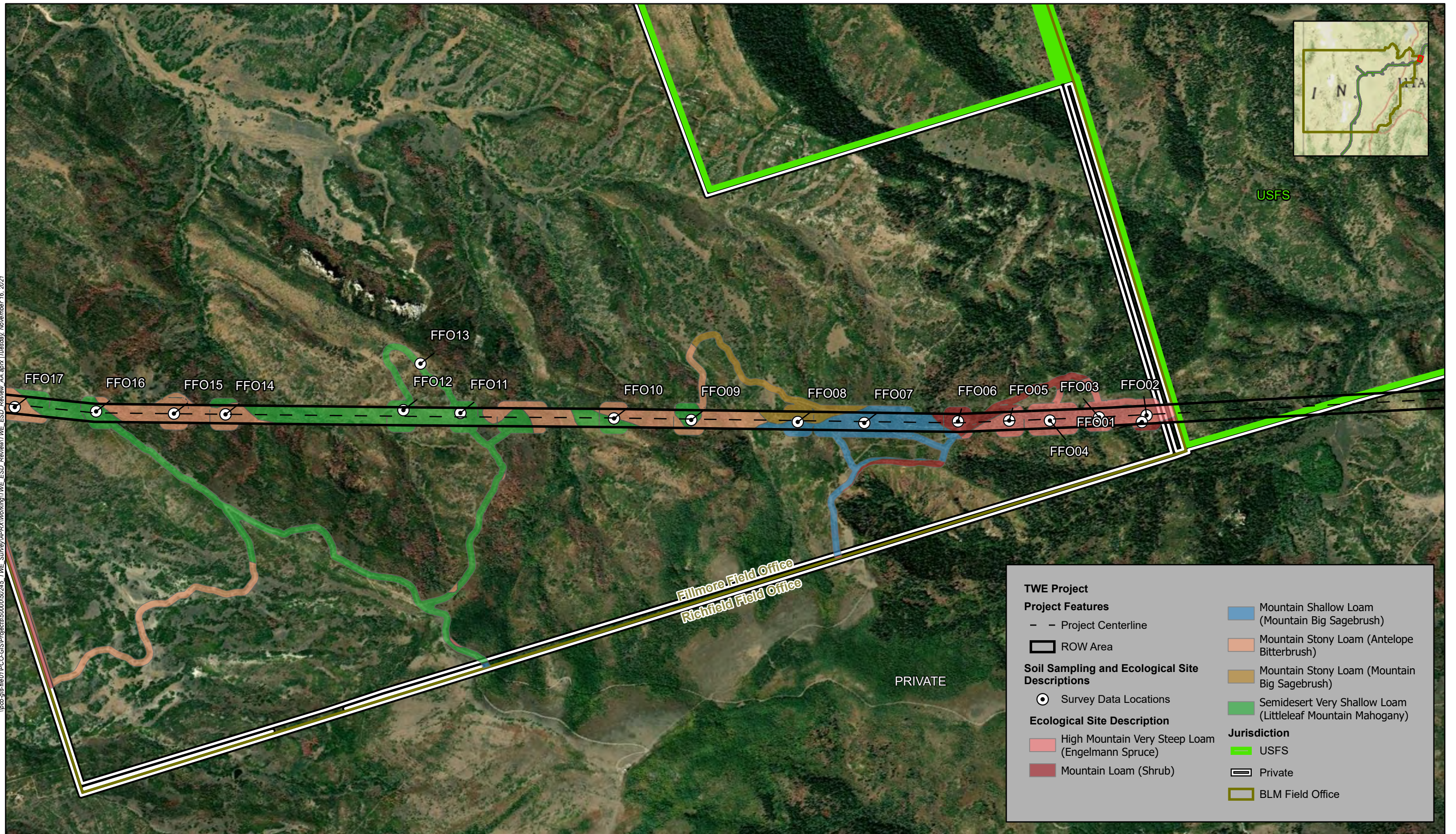


**Figure F-1-26 Representative Upland Stony Loam (Wyoming Big Sagebrush) in the Fillmore FO.
Site ID 0420SF10.**

ATTACHMENT F-2

Fillmore Field Office Maps

\\pcc-jis-file01\PCOG-GIS\Projects\50000\50245_TWE_Survey\APRX\Working\TWE_ESD_Review\TWE_ESD_Review_A4.aprx [Tuesday, November 16, 2021]



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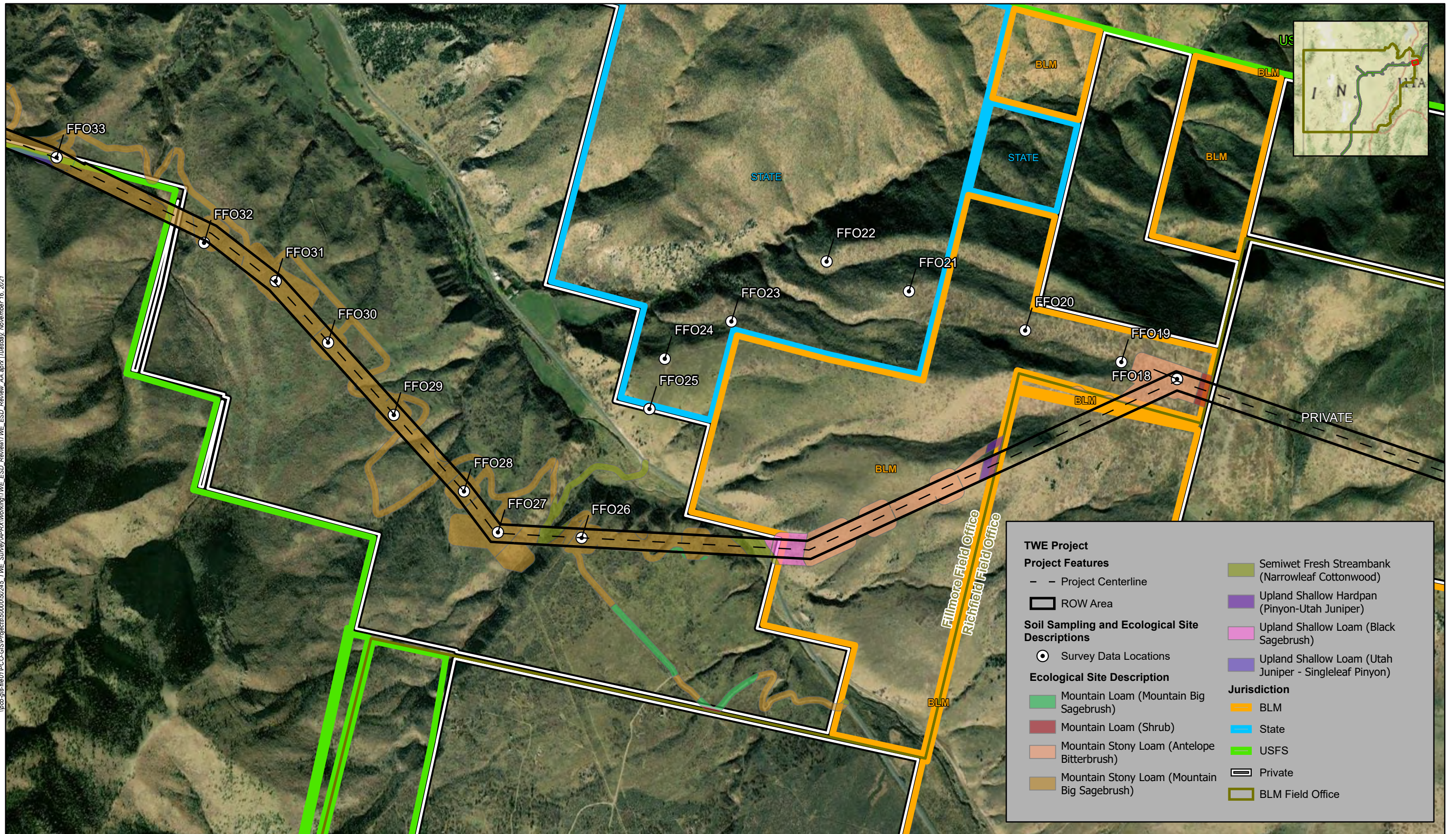
Project Design Date: 08/30/2021
Source: BLM 2015

Map 1 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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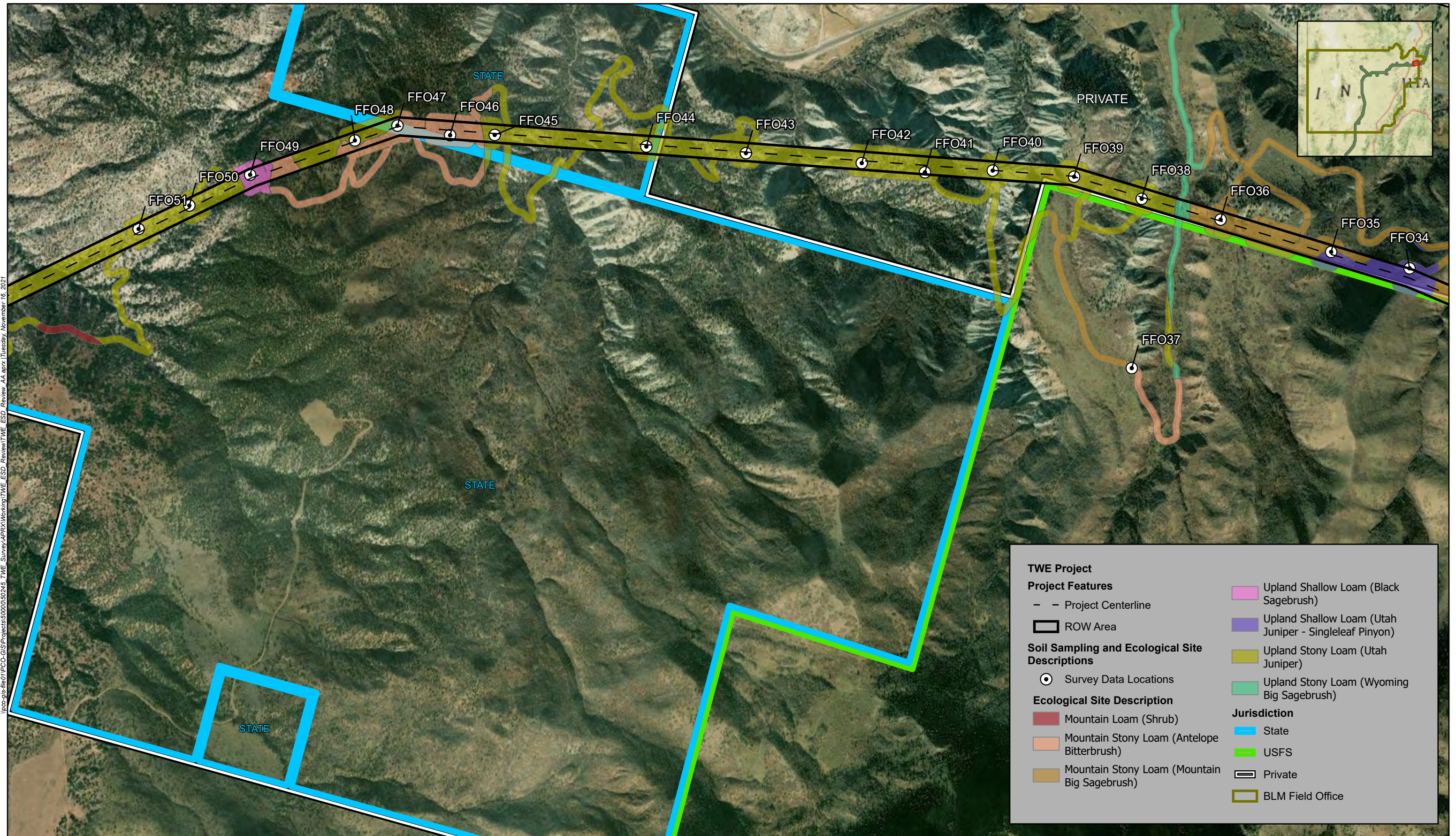
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Project Design Date: 08/30/2021
Source: BLM 2015

Map 2 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



\\pcc-gis\file01\PCOC-GIS\Projects\50000\50245_TWE_Survey\APRX\Working\TWE_ESD_Review\TWE_ESD_Review 44.aprx [Tuesday, November 16, 2021]



TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- ⊙ Survey Data Locations

Ecological Site Description

- Mountain Loam (Shrub)
- Mountain Stony Loam (Antelope Bitterbrush)
- Mountain Stony Loam (Mountain Big Sagebrush)

- Upland Shallow Loam (Black Sagebrush)
- Upland Shallow Loam (Utah Juniper - Singleleaf Pinyon)
- Upland Stony Loam (Utah Juniper)
- Upland Stony Loam (Wyoming Big Sagebrush)

Jurisdiction

- State
- USFS
- Private
- BLM Field Office



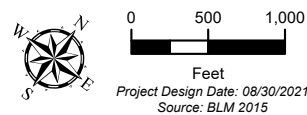
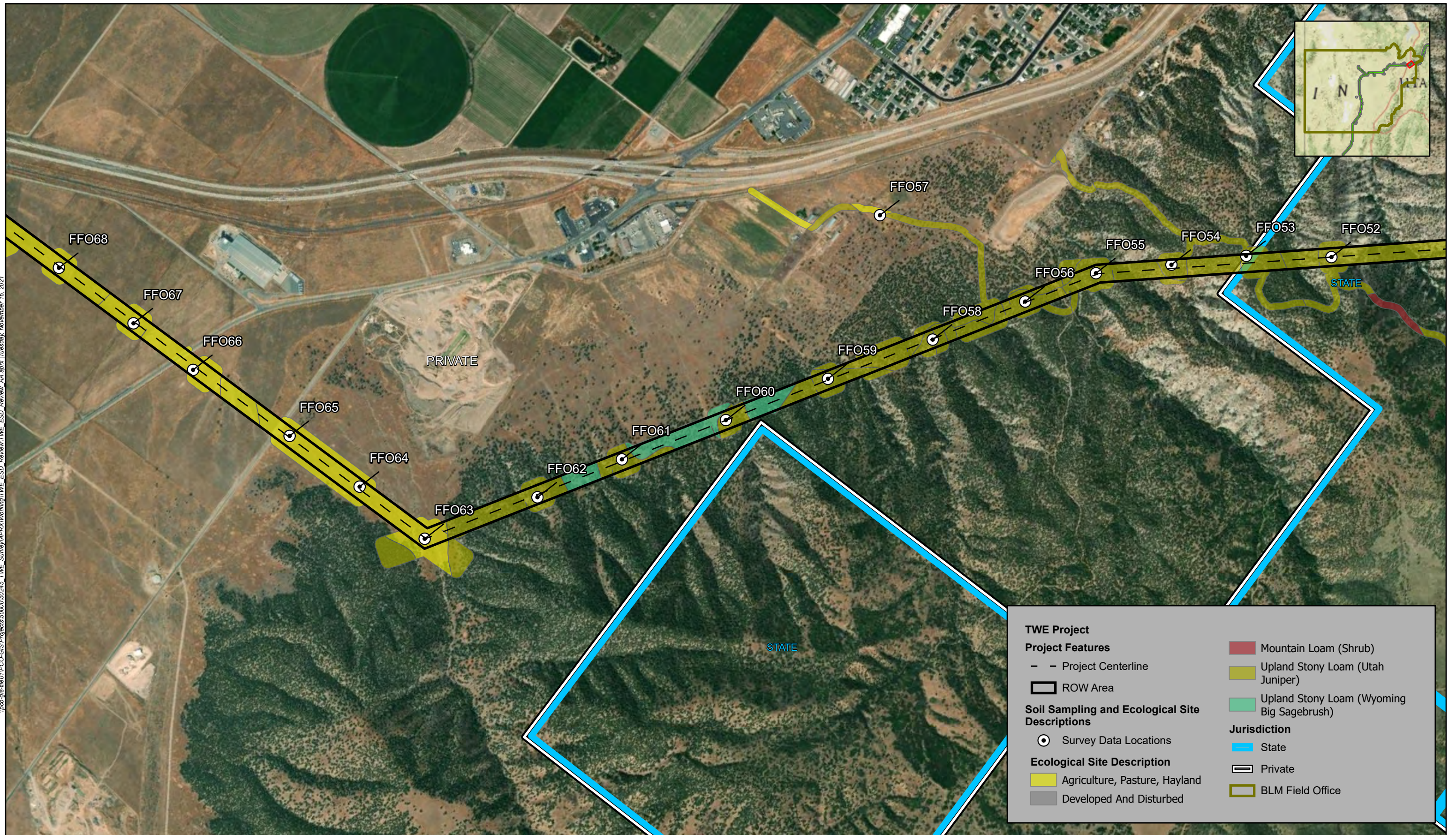
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Project Design Date: 08/30/2021
Source: BLM 2015

Map 3 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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TWE Project

Project Features

Project Centerline

ROW Area

Soil Sampling and Ecological Site Descriptions

Survey Data Locations

Ecological Site Description

Agriculture, Pasture, Hayland

Upland Stony Loam (Pinyon-Utah Juniper)

Jurisdiction

BLM

Private

BLM Field Office

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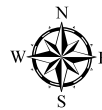
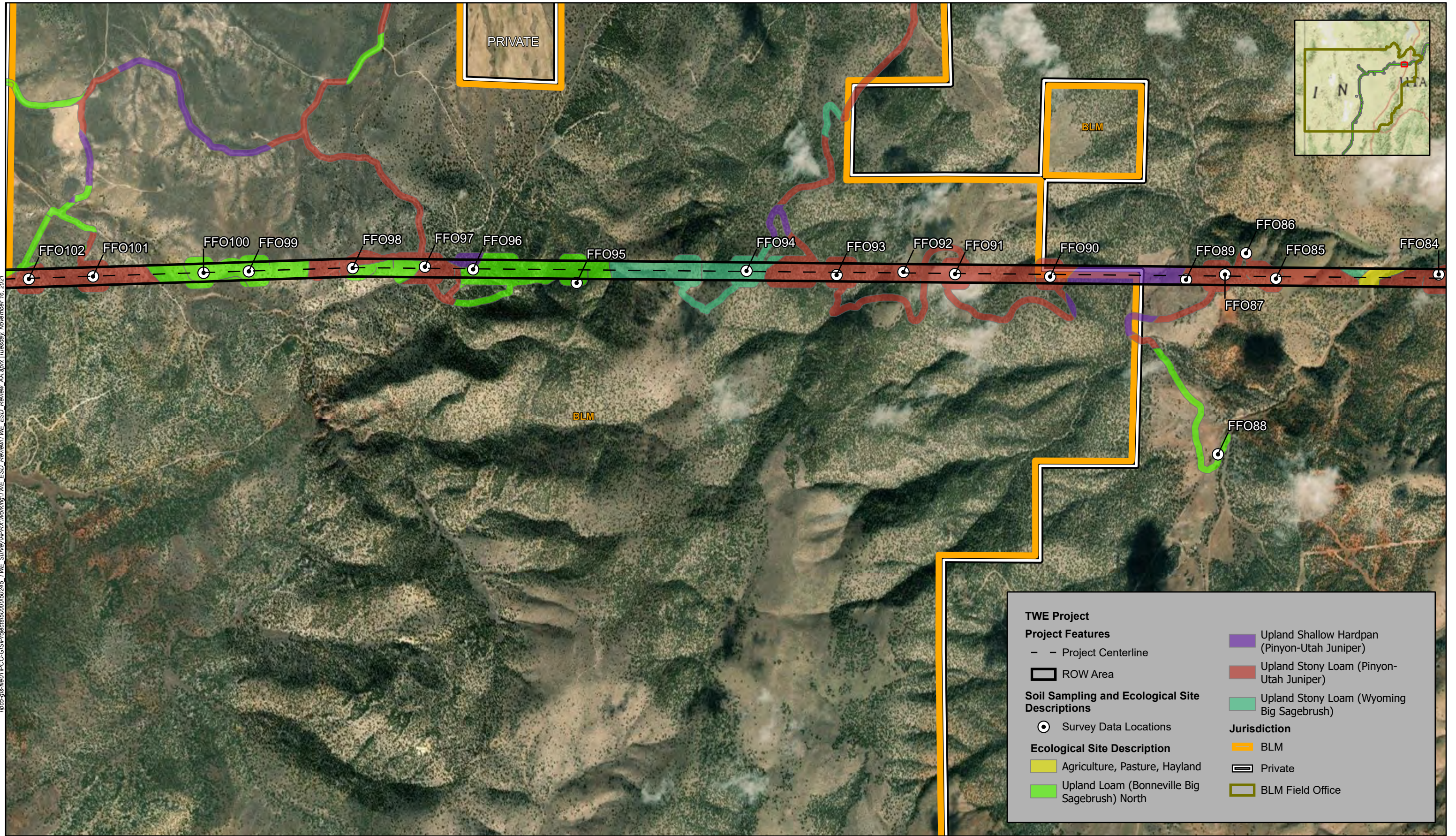
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Source: BLM 2015



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Project Design Date: 08/30/2021
Source: BLM 2015

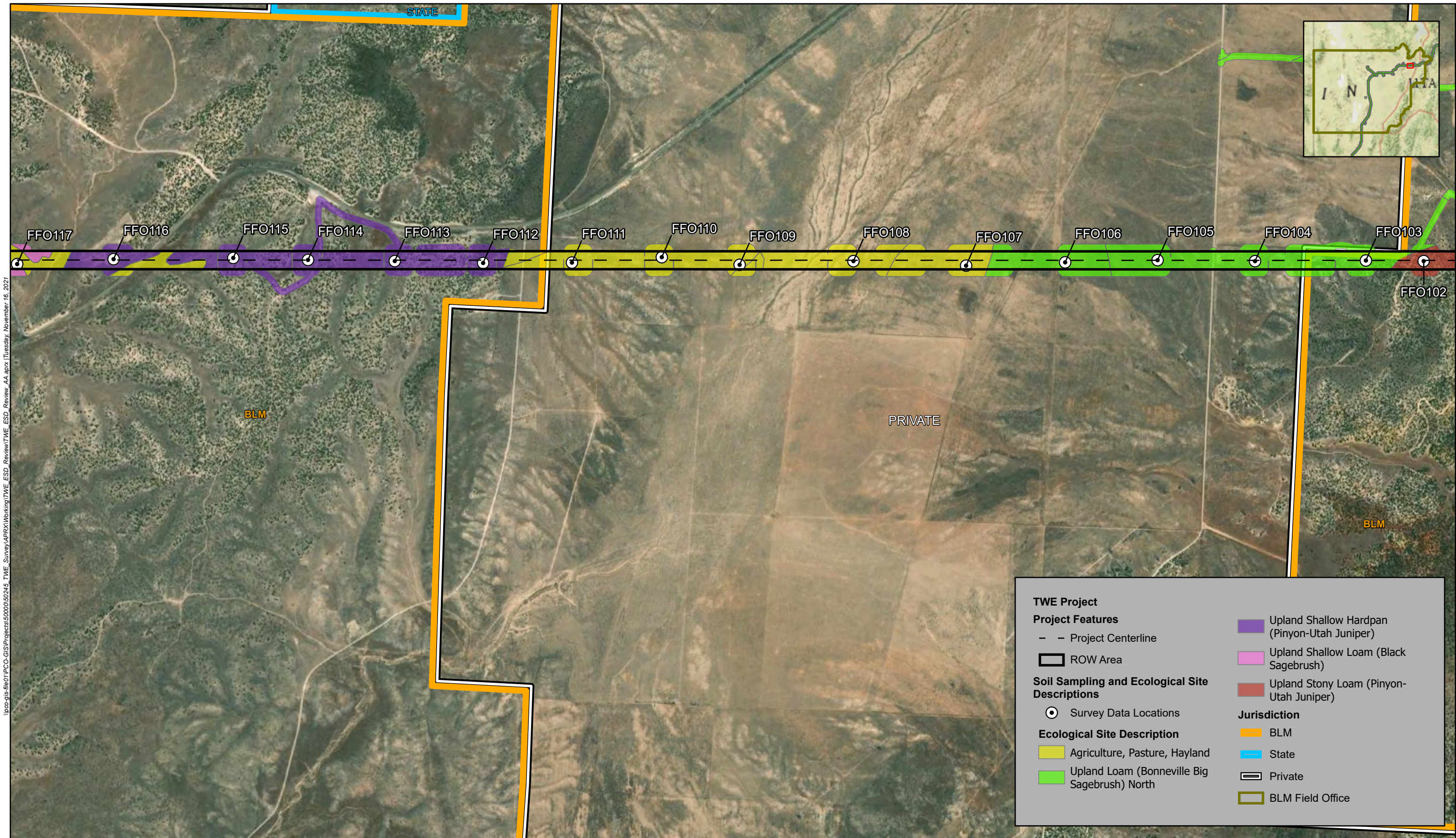
Map 6 of 42

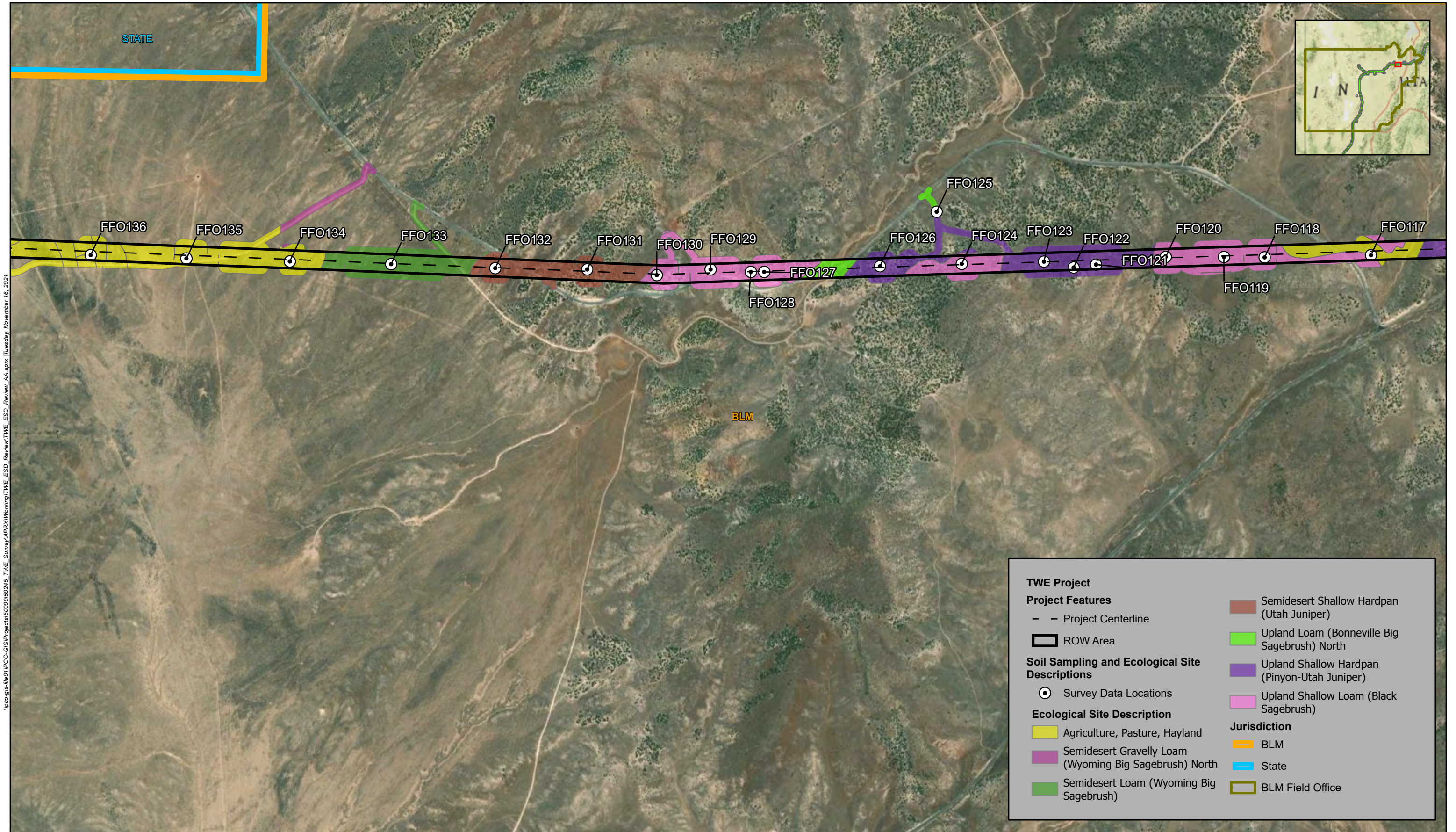
Ecological Site Descriptions- Fillmore Field Office

TransWest Express Transmission Project

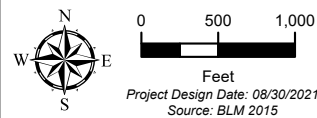


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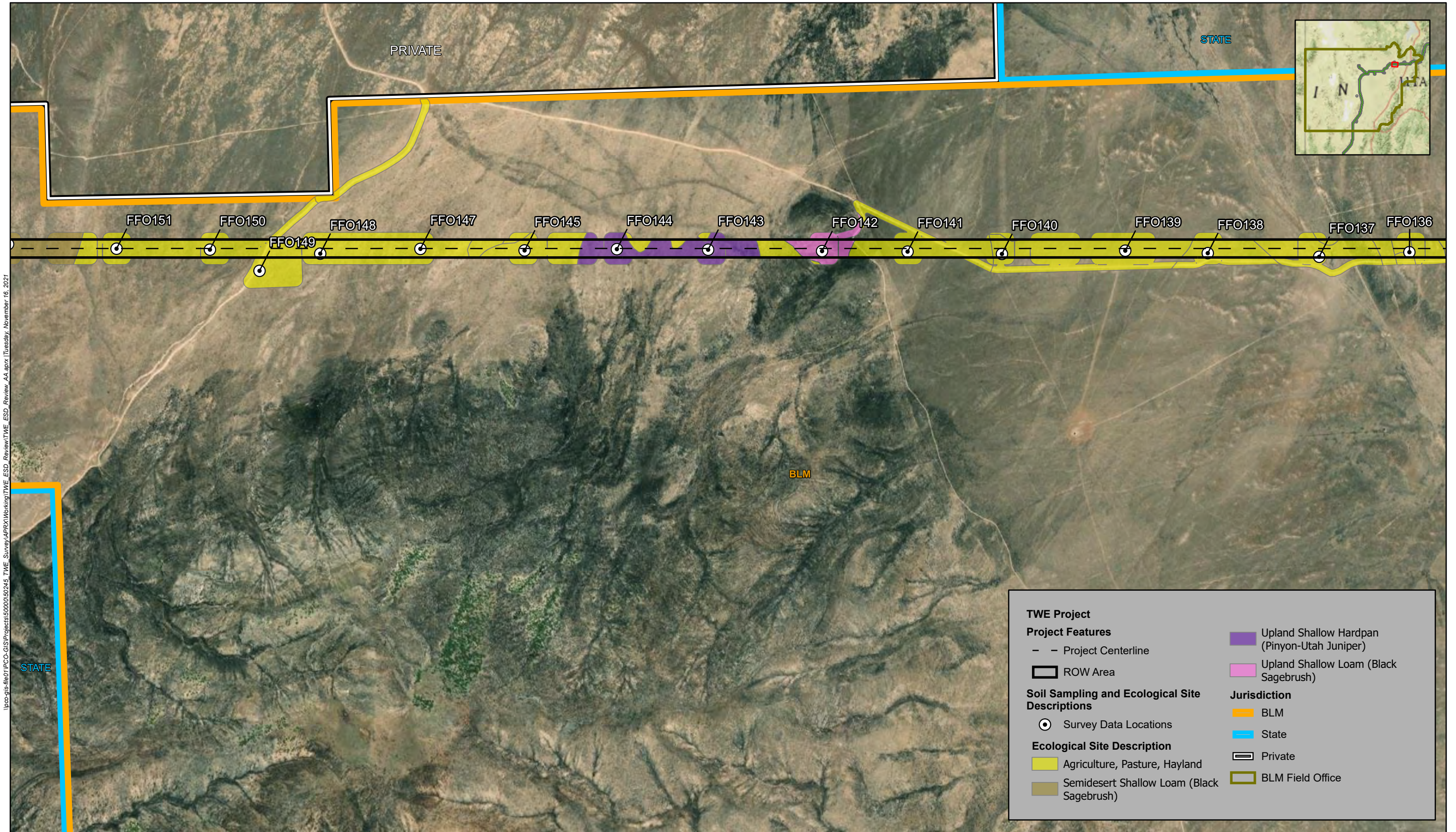
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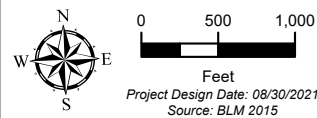
Map 8 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project

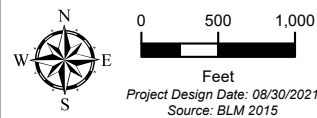
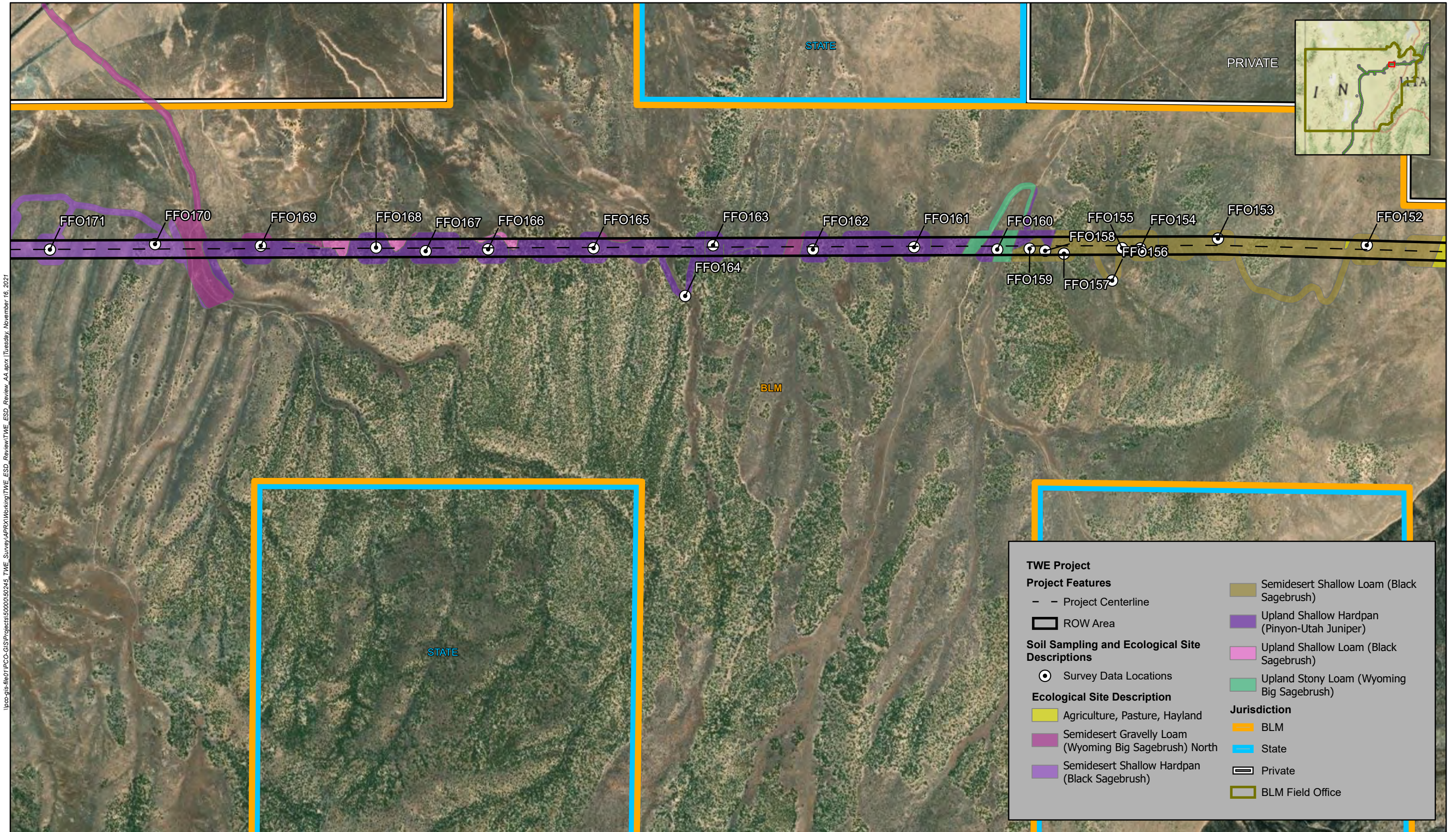


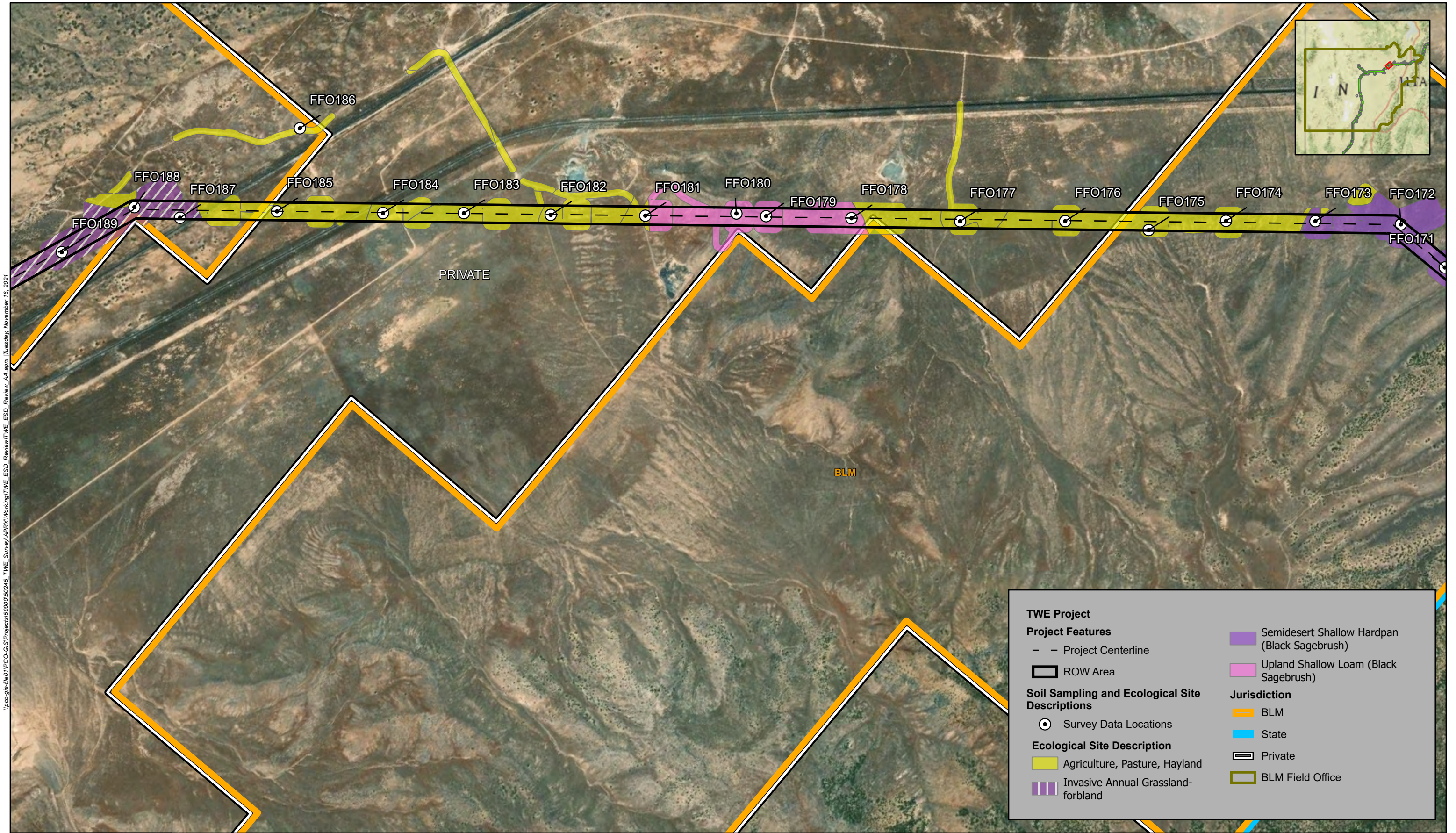


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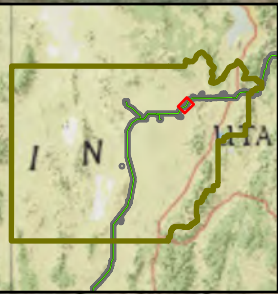


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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

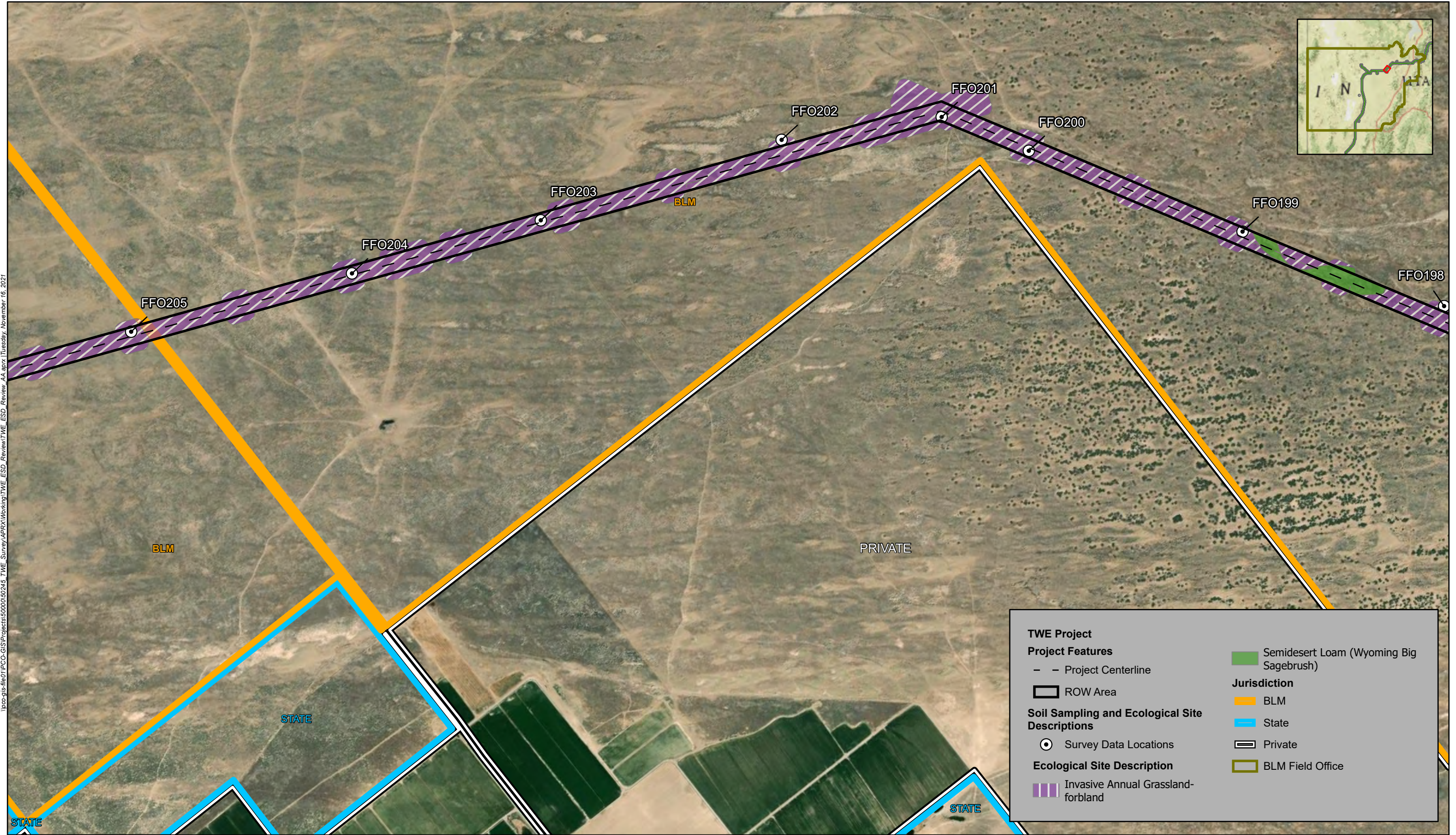
- ⊙ Survey Data Locations

Ecological Site Description

- Agriculture, Pasture, Hayland
- Invasive Annual Grassland-forbland

Jurisdiction

- ▭ BLM
- ▭ Private
- ▭ BLM Field Office



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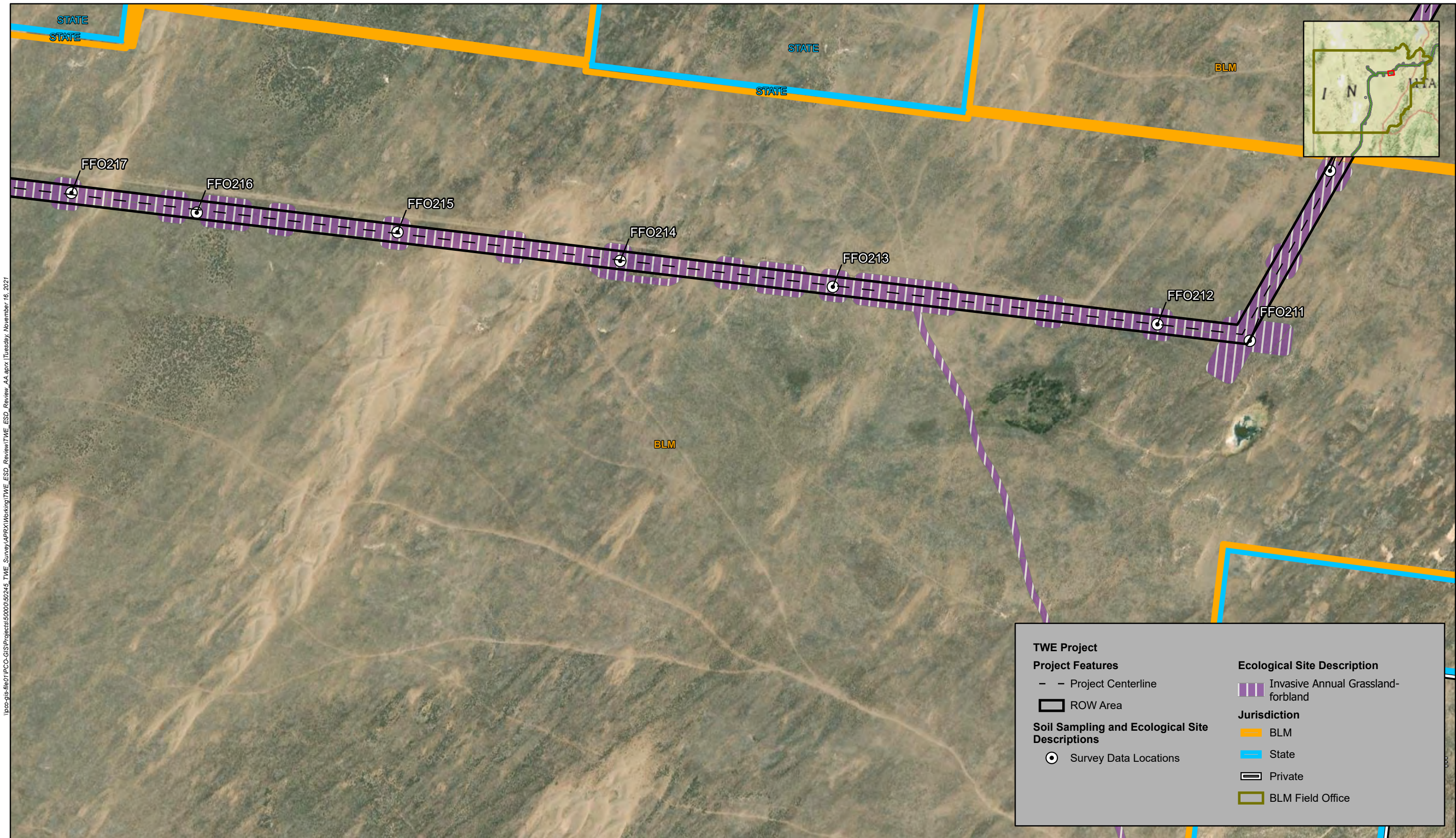
Project Design Date: 08/30/2021
Source: BLM 2015

Map 13 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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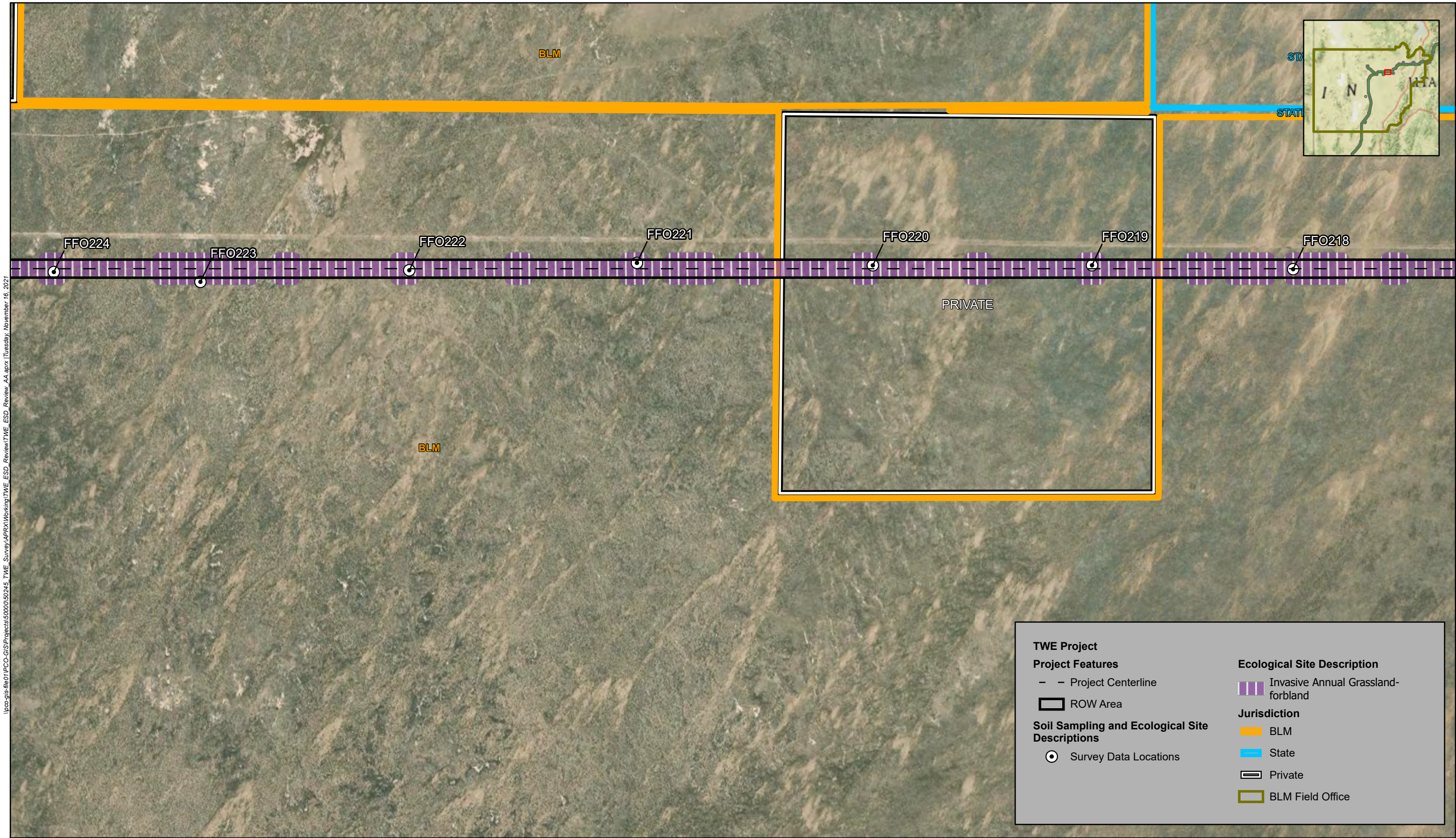
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Project Design Date: 08/30/2021
Source: BLM 2015

Map 14 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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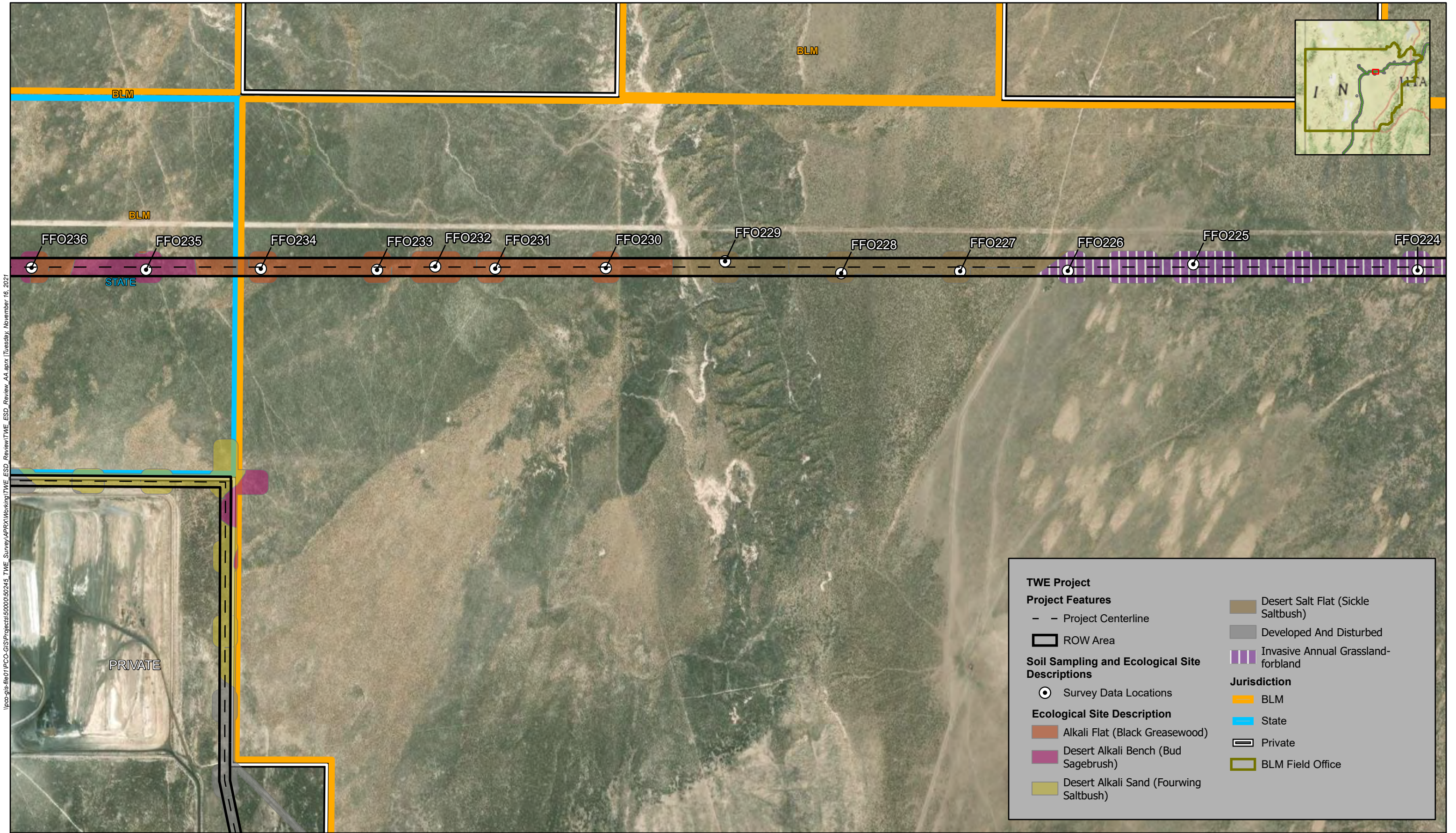
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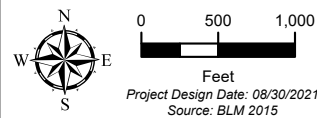
Map 15 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project





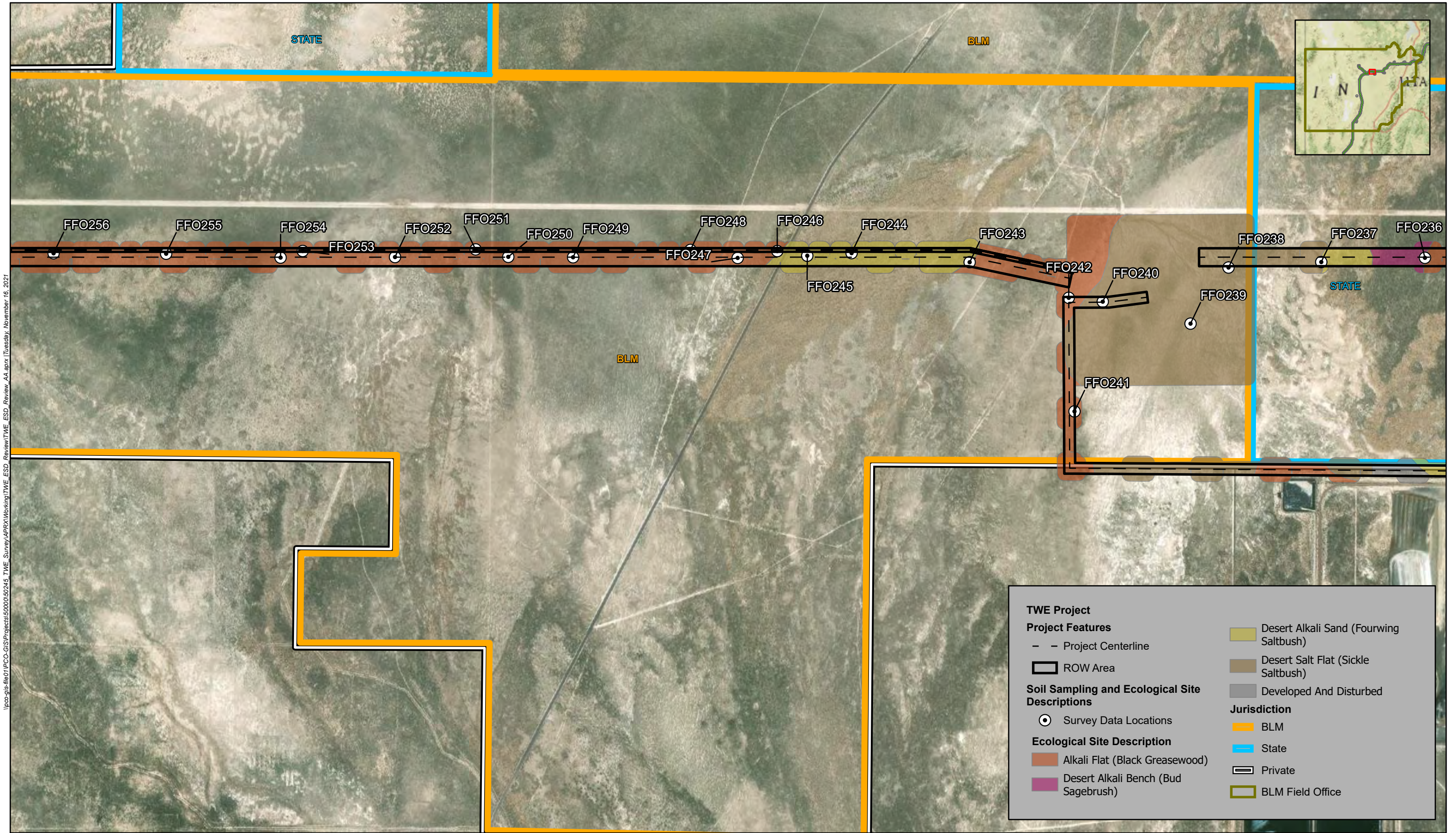
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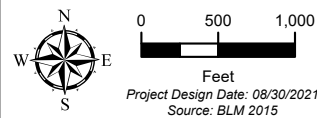
Map 16 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project





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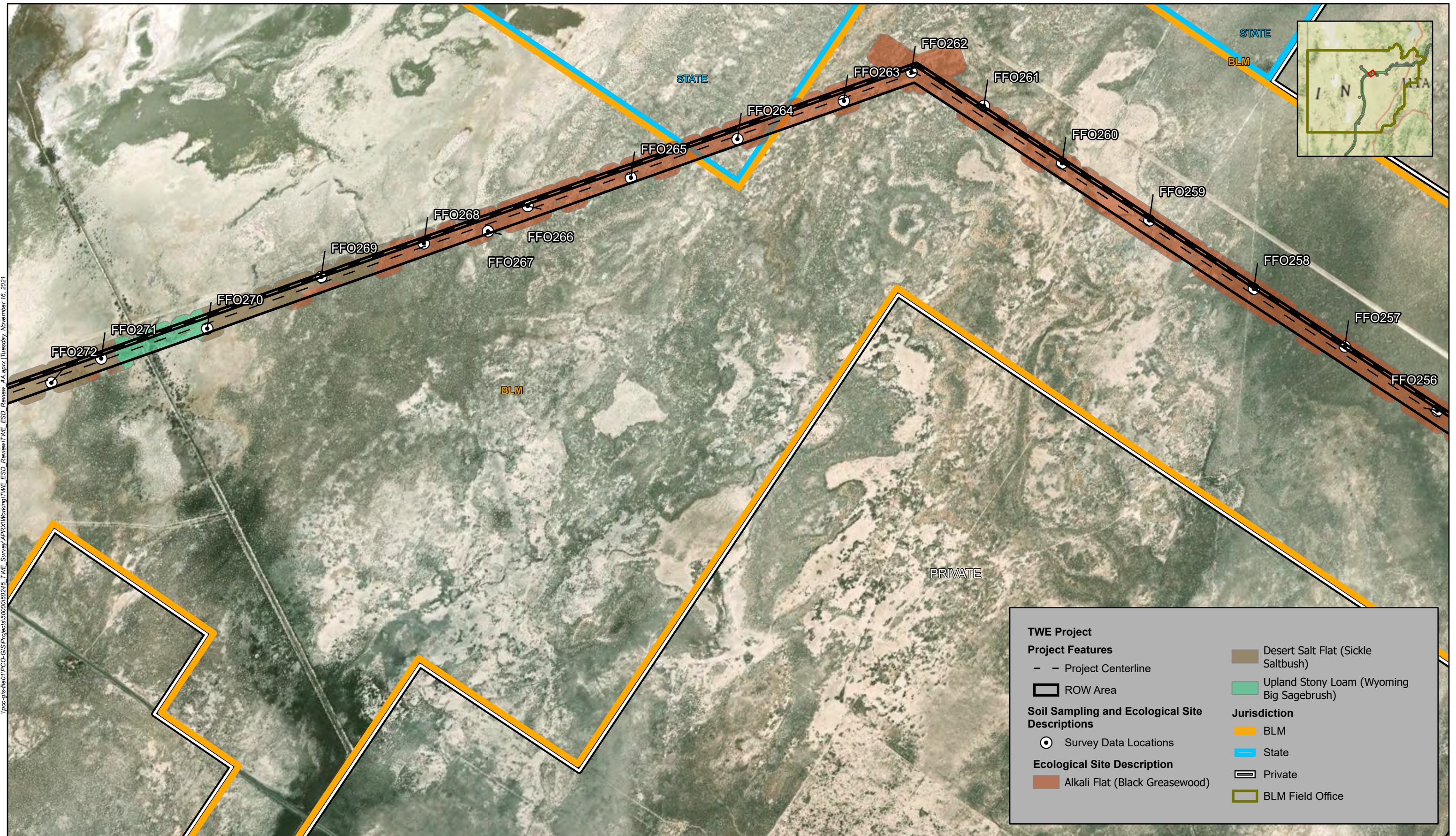


Map 17 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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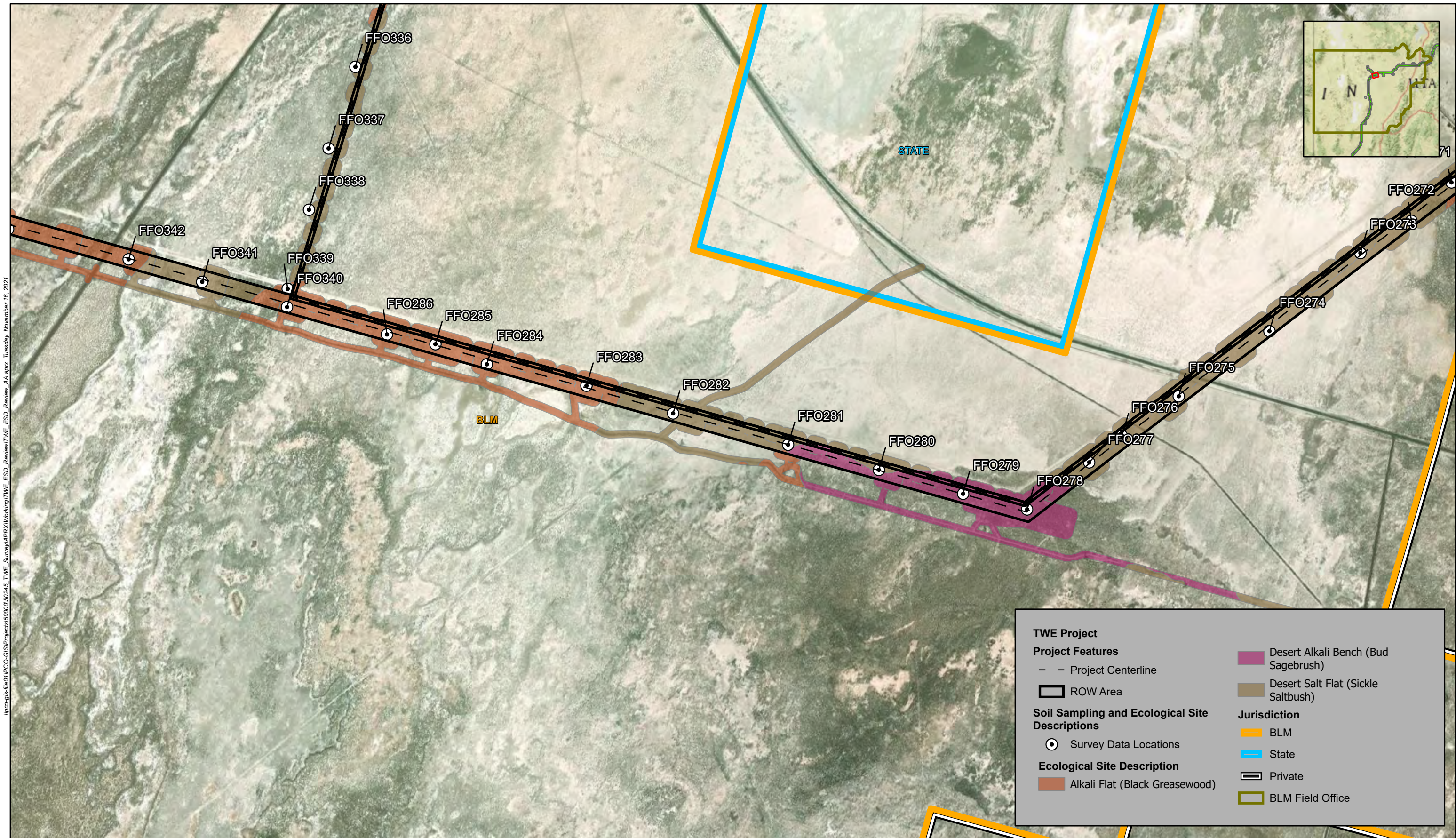
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Source: BLM 2015

Map 18 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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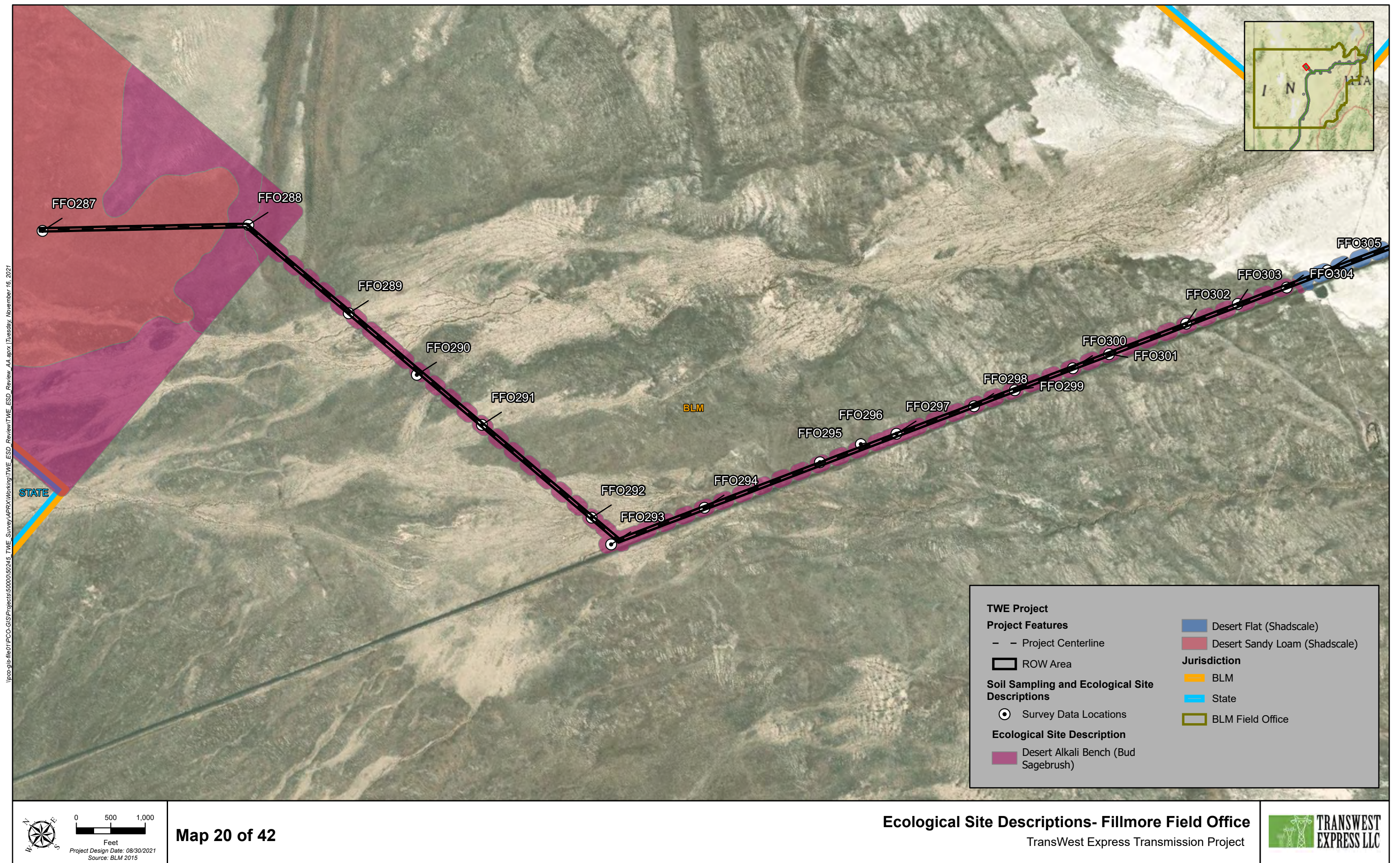


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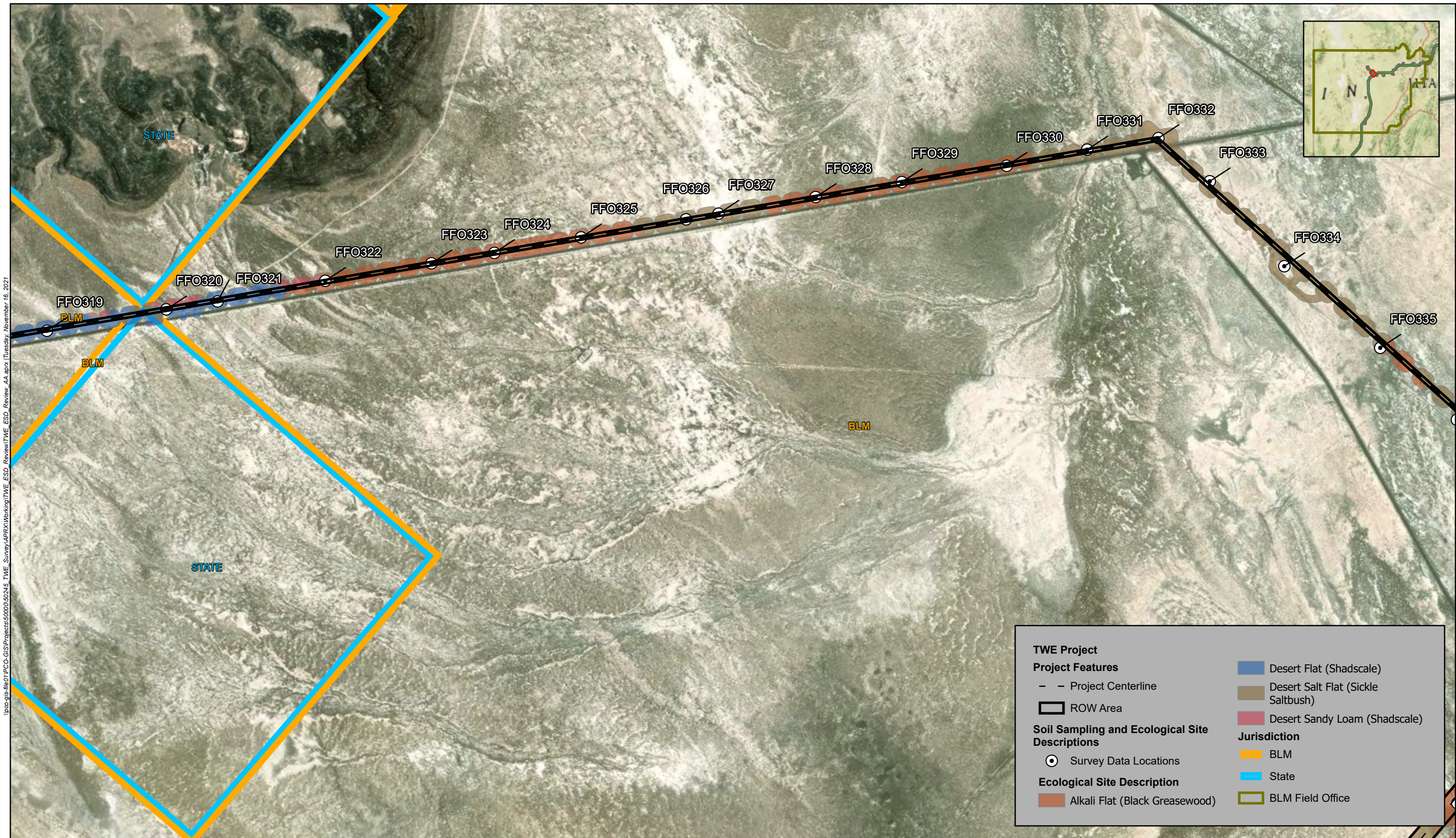
Map 19 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project





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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- ⊙ Survey Data Locations

Ecological Site Description

- Alkali Flat (Black Greasewood)

- Desert Flat (Shadscale)
- Desert Salt Flat (Sickle Saltbush)
- Desert Sandy Loam (Shadscale)

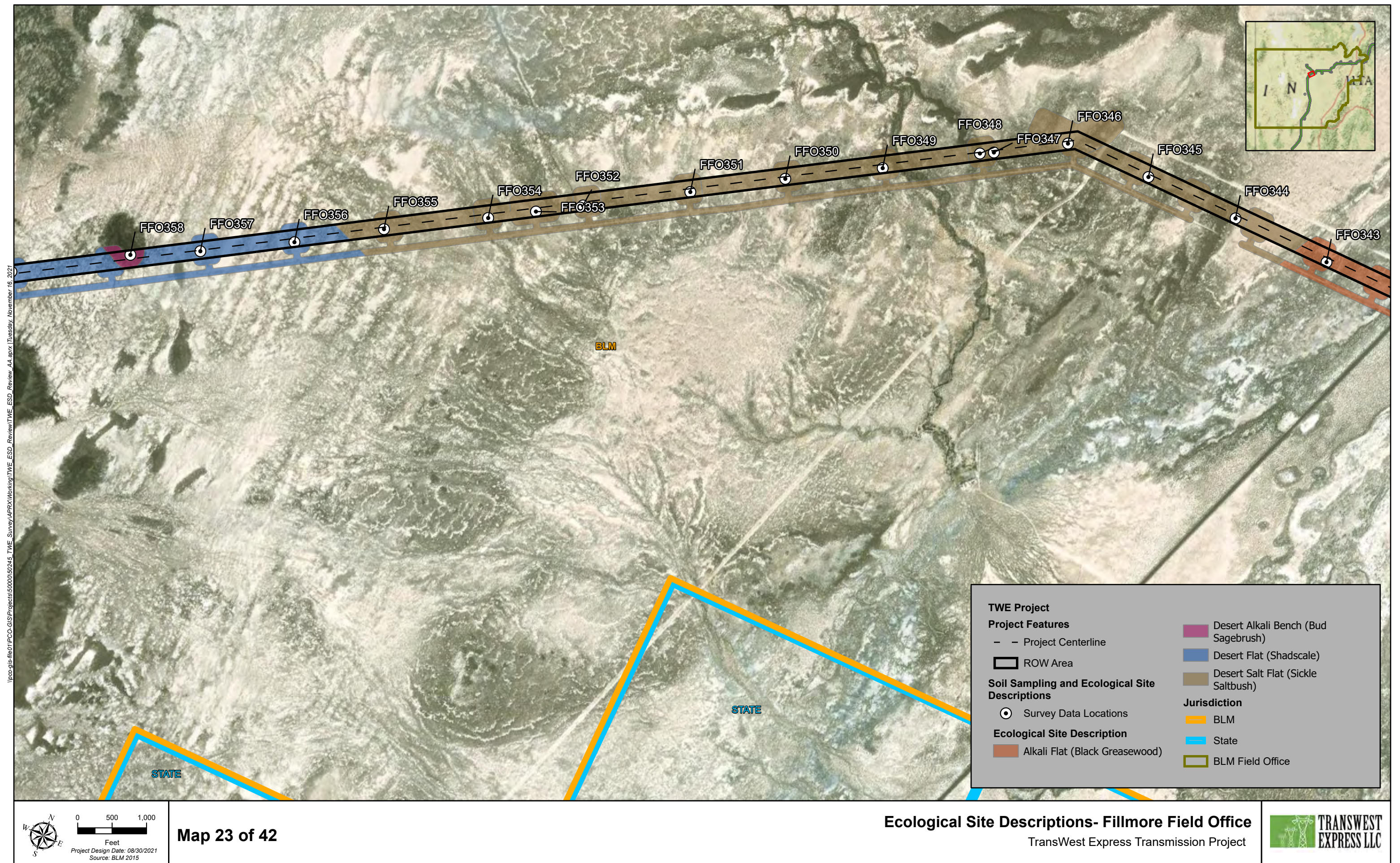
Jurisdiction

- BLM
- State
- BLM Field Office



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Project Design Date: 08/30/2021
Source: BLM 2015





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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- Survey Data Locations

Ecological Site Description

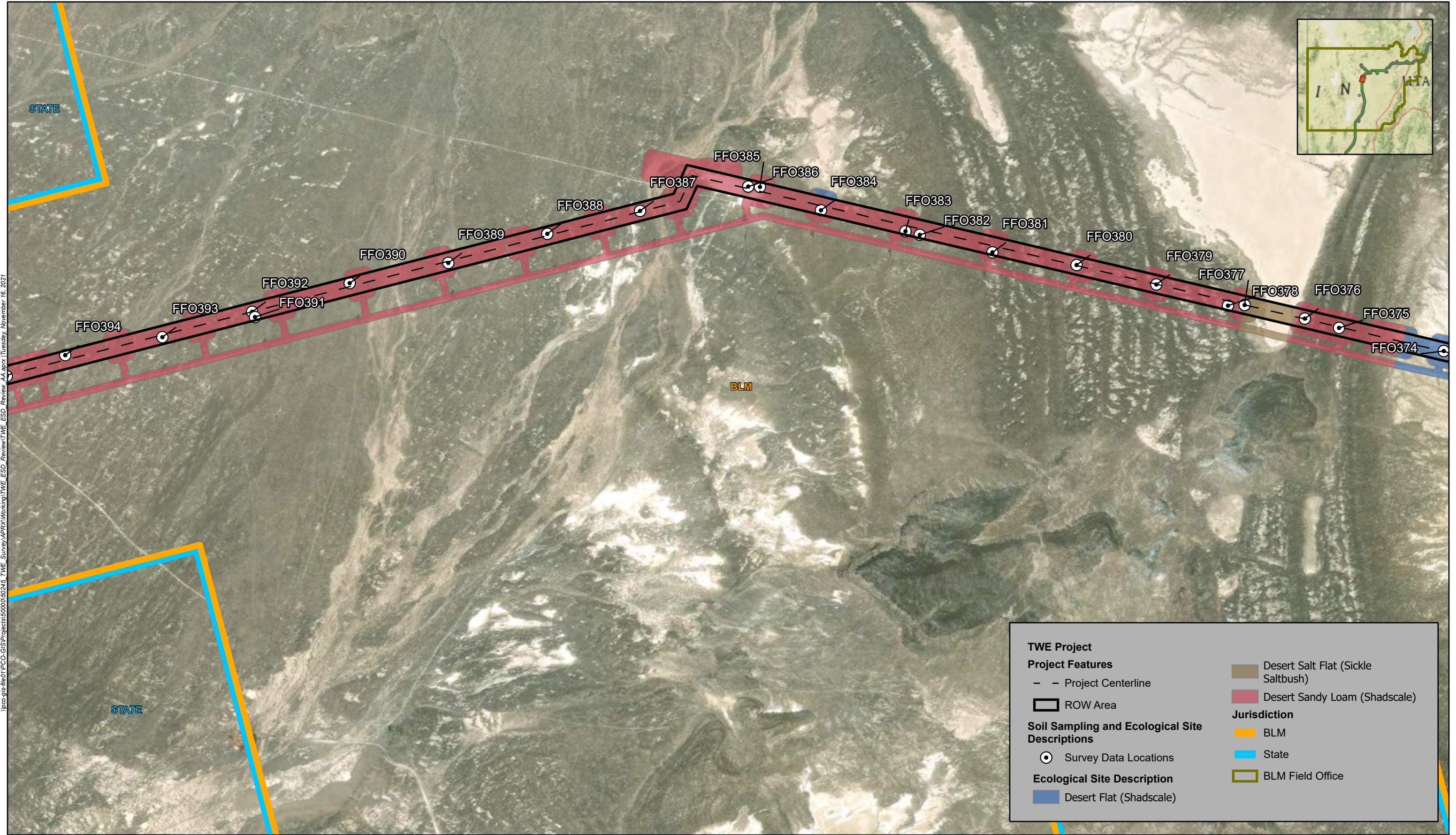
- ▭ Desert Flat (Shadscale)
- ▭ Desert Sandy Loam (Shadscale)

Jurisdiction

- ▬ BLM
- ▬ State
- ▭ BLM Field Office

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Project Design Date: 08/30/2021
Source: BLM 2015





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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- ⊙ Survey Data Locations

Ecological Site Description

- ▭ Desert Flat (Shadscale)

- ▭ Desert Salt Flat (Sickle Saltbush)
- ▭ Desert Sandy Loam (Shadscale)

Jurisdiction

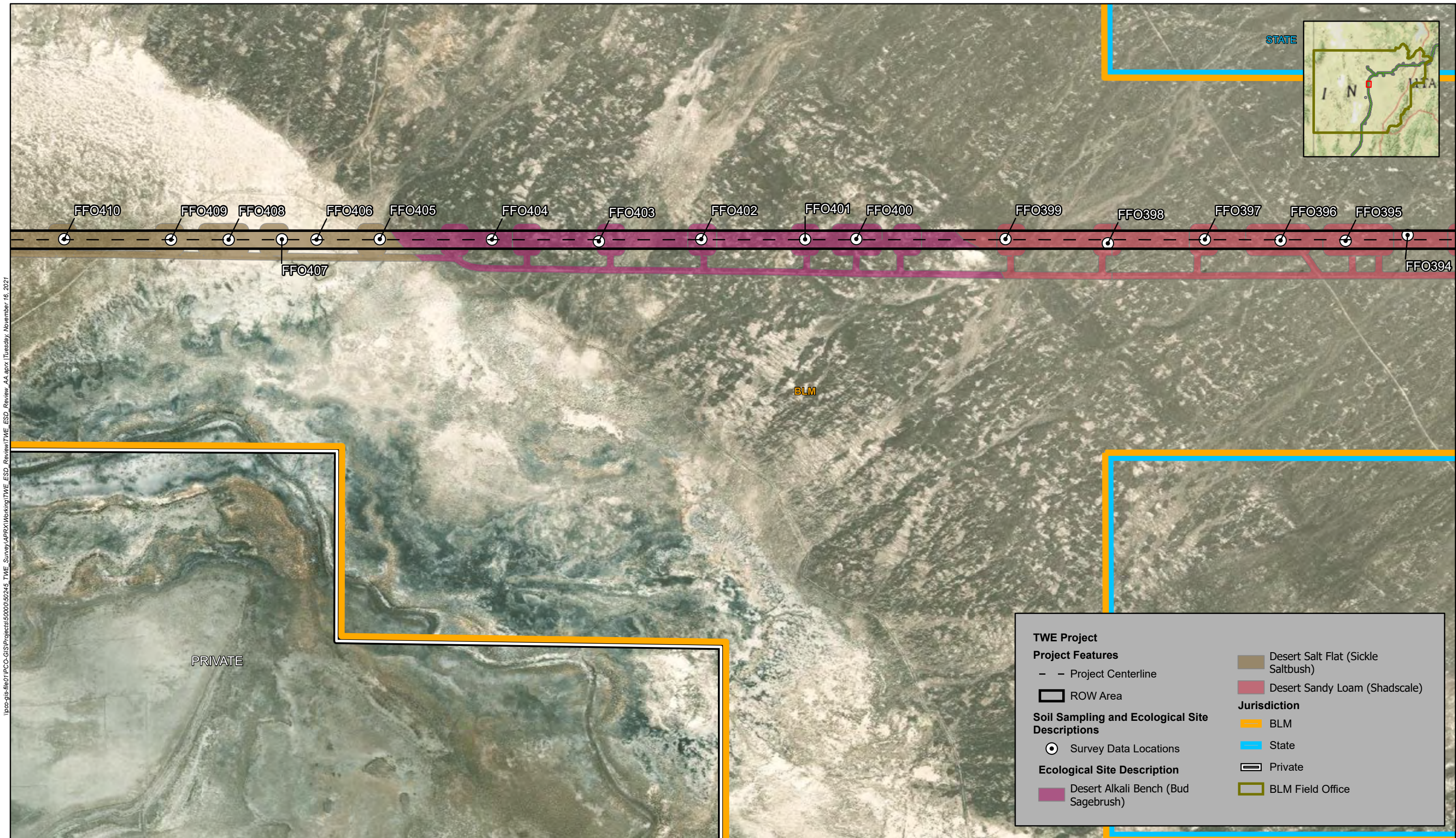
- ▭ BLM
- ▭ State
- ▭ BLM Field Office

Project Design Date: 08/30/2021

Source: BLM 2015



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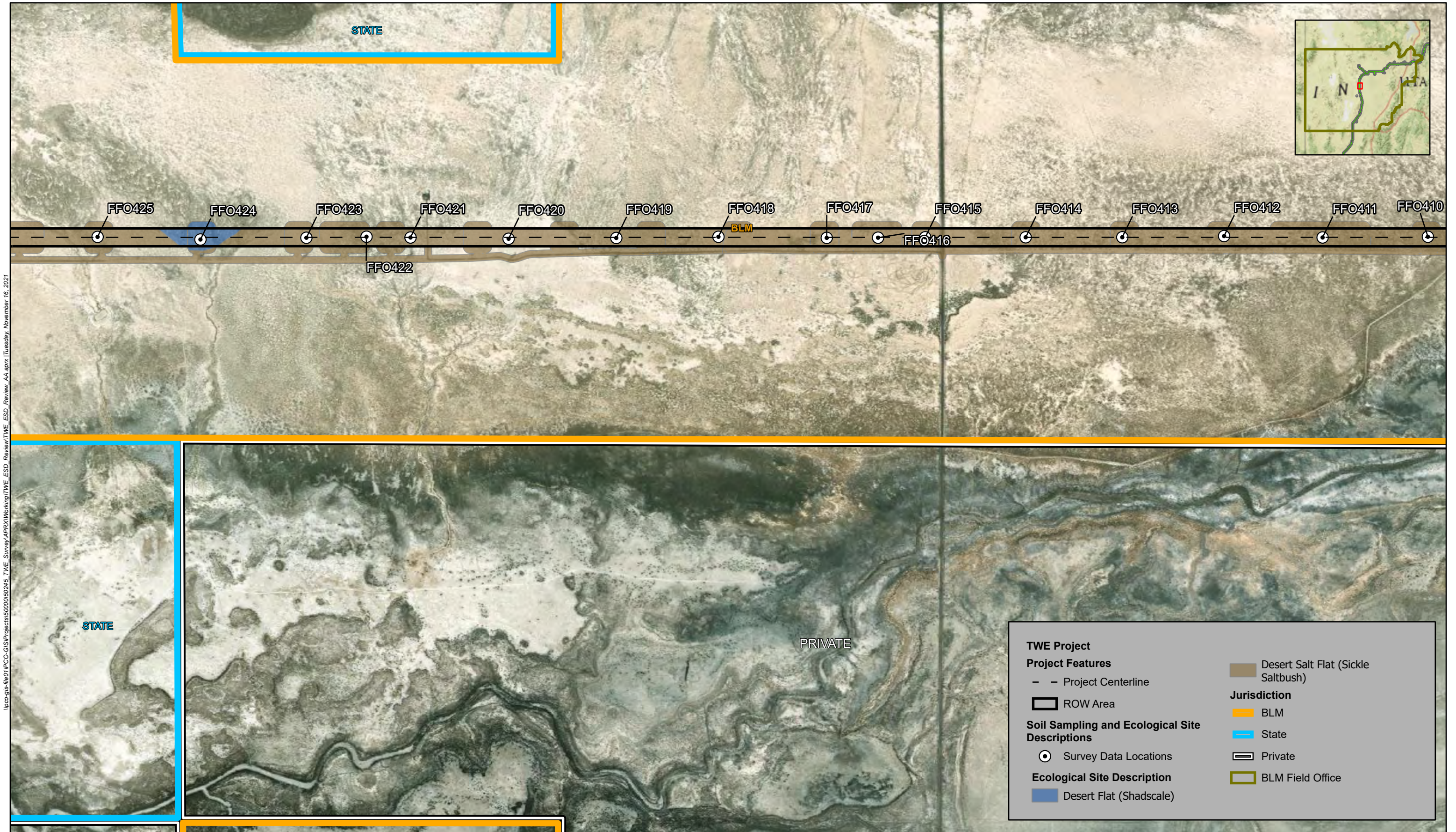


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Source: BLM 2015

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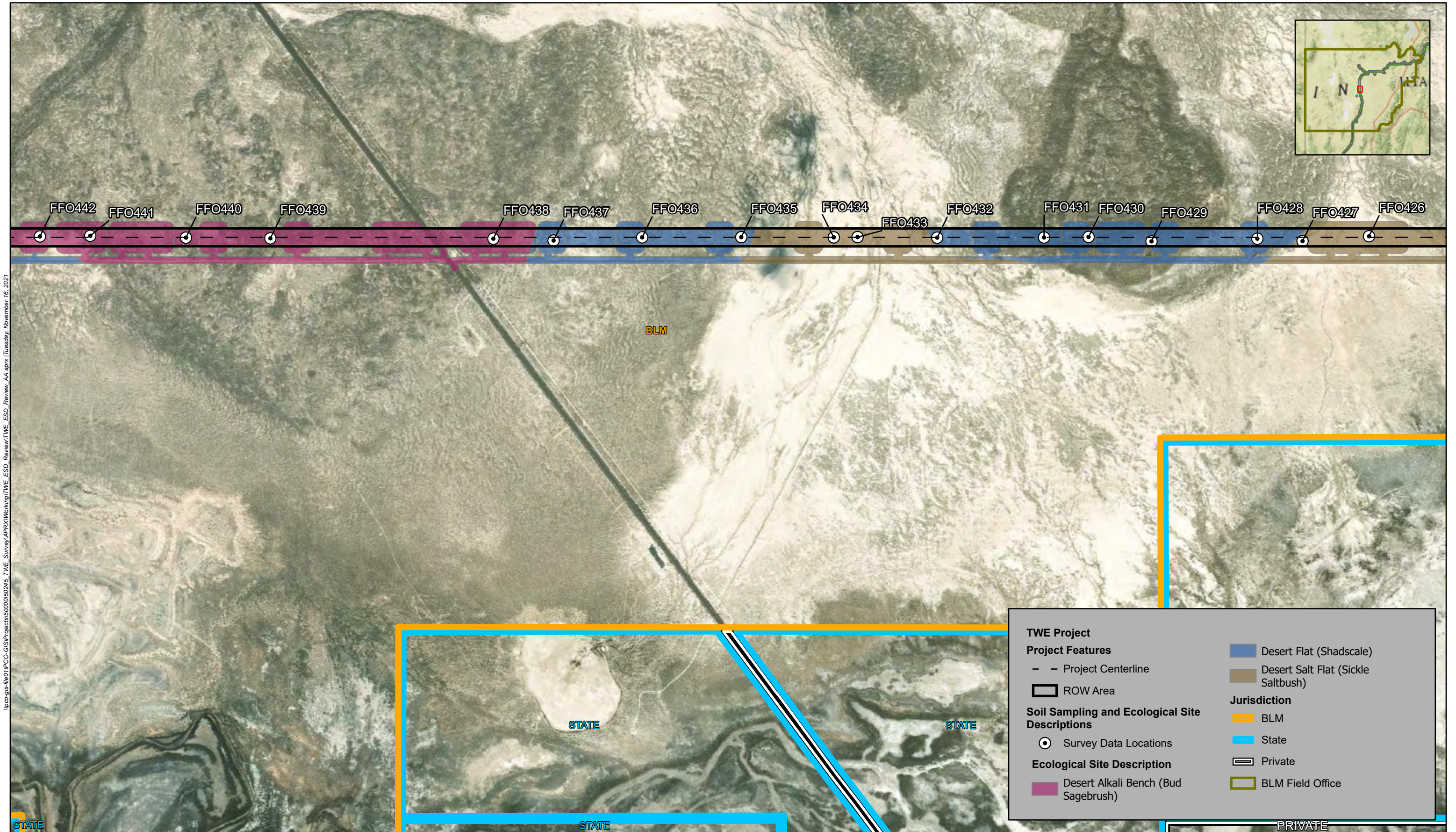
Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project

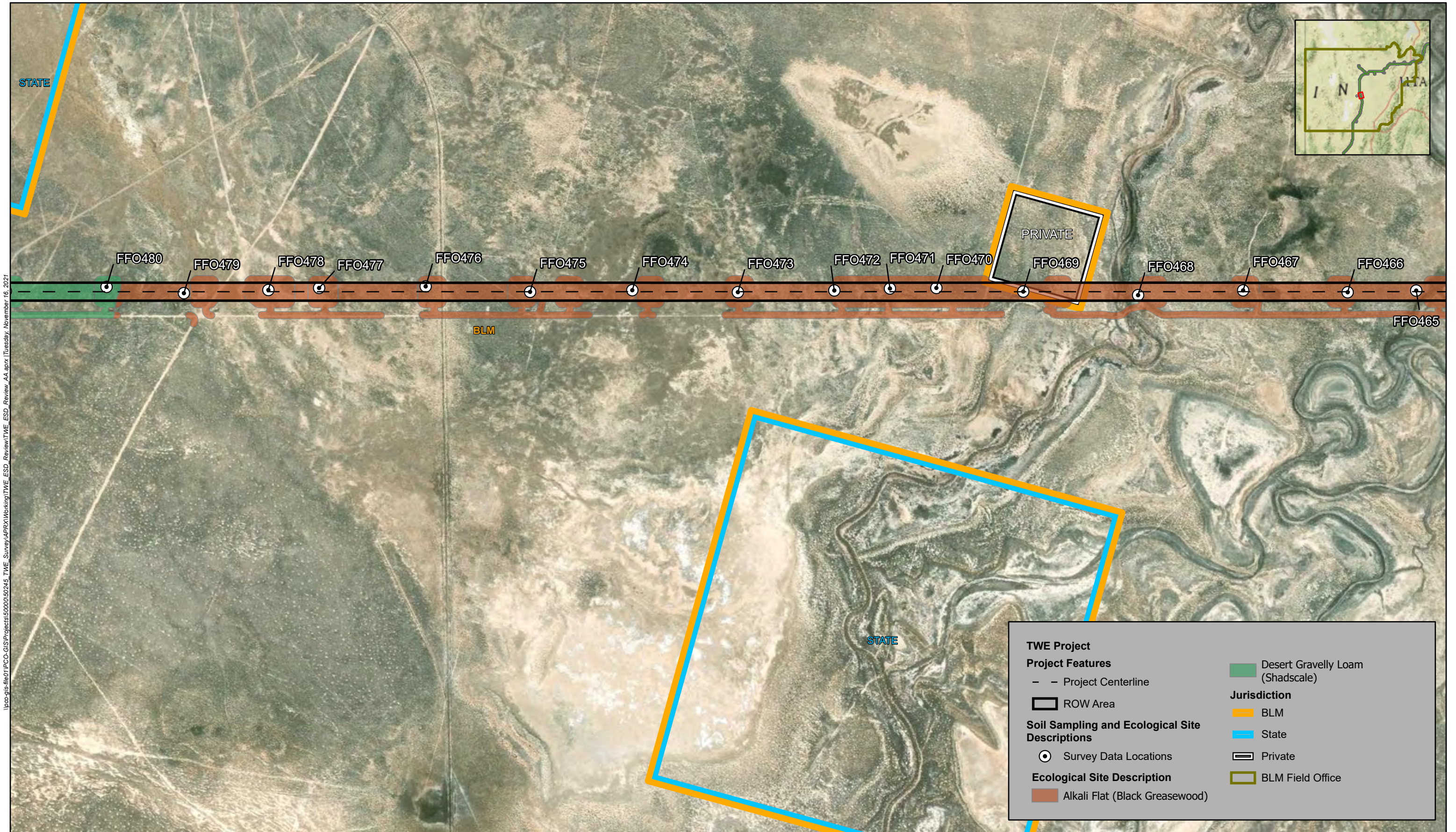




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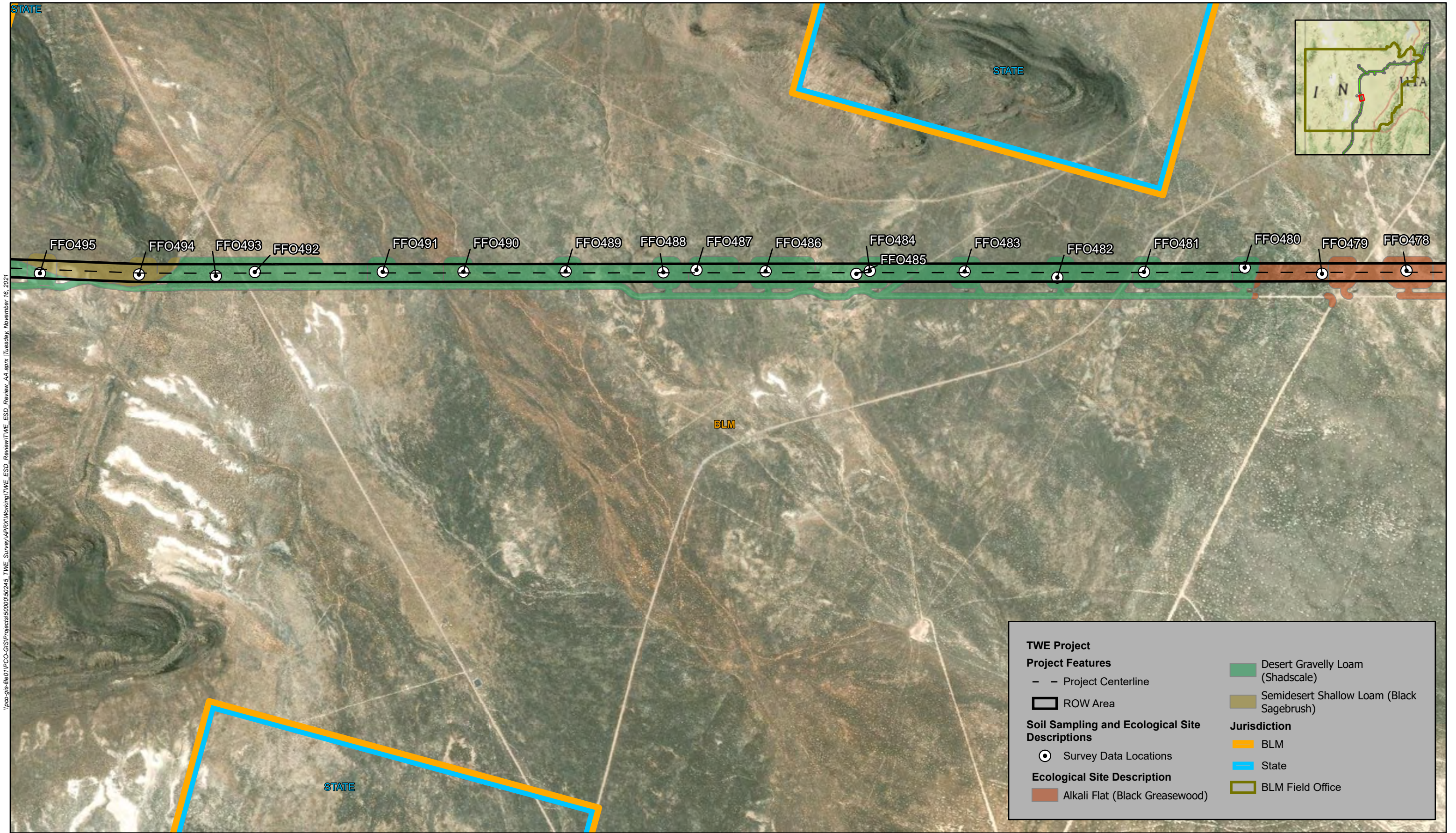


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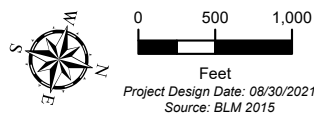
Map 30 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project





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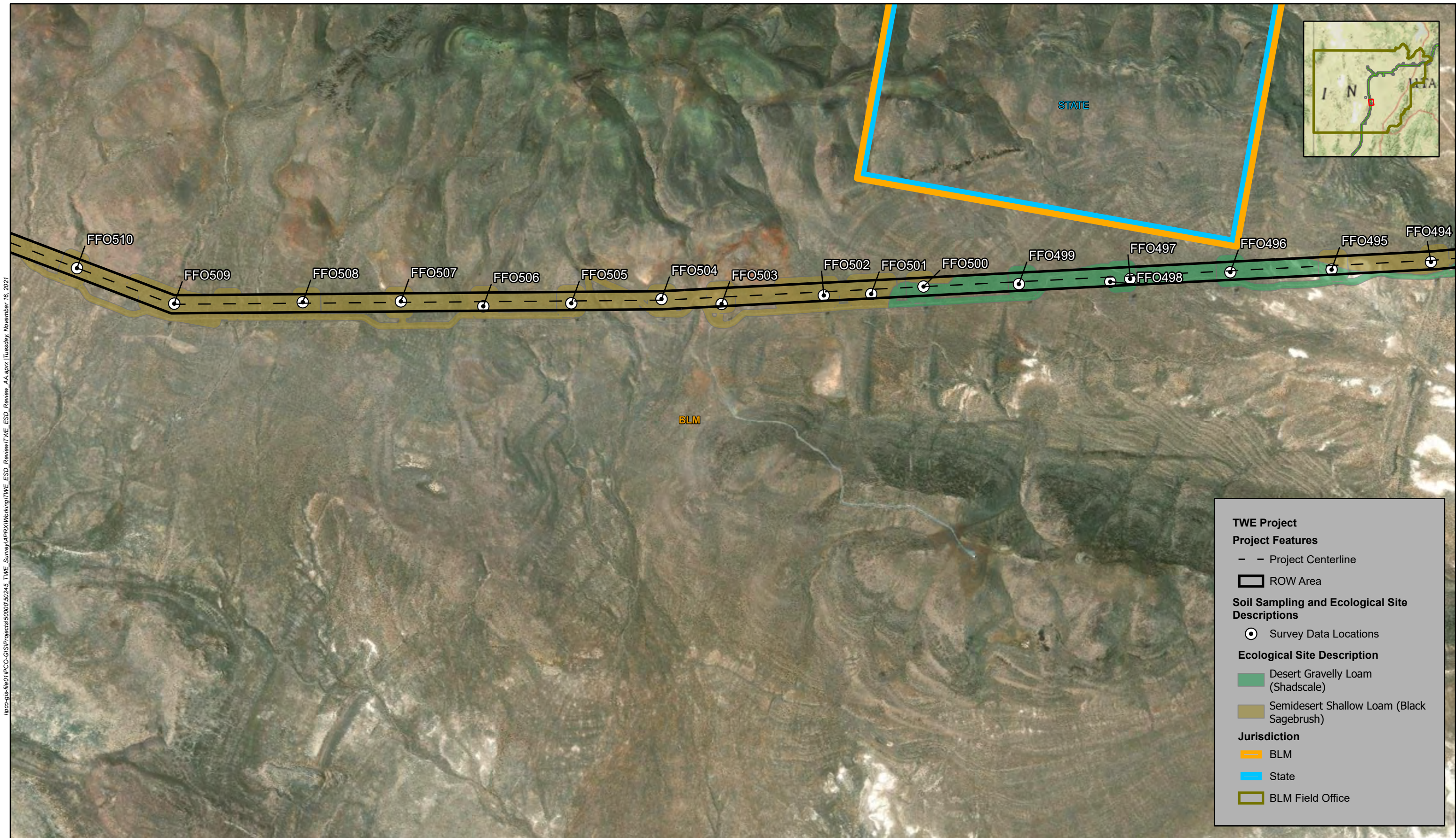


Map 31 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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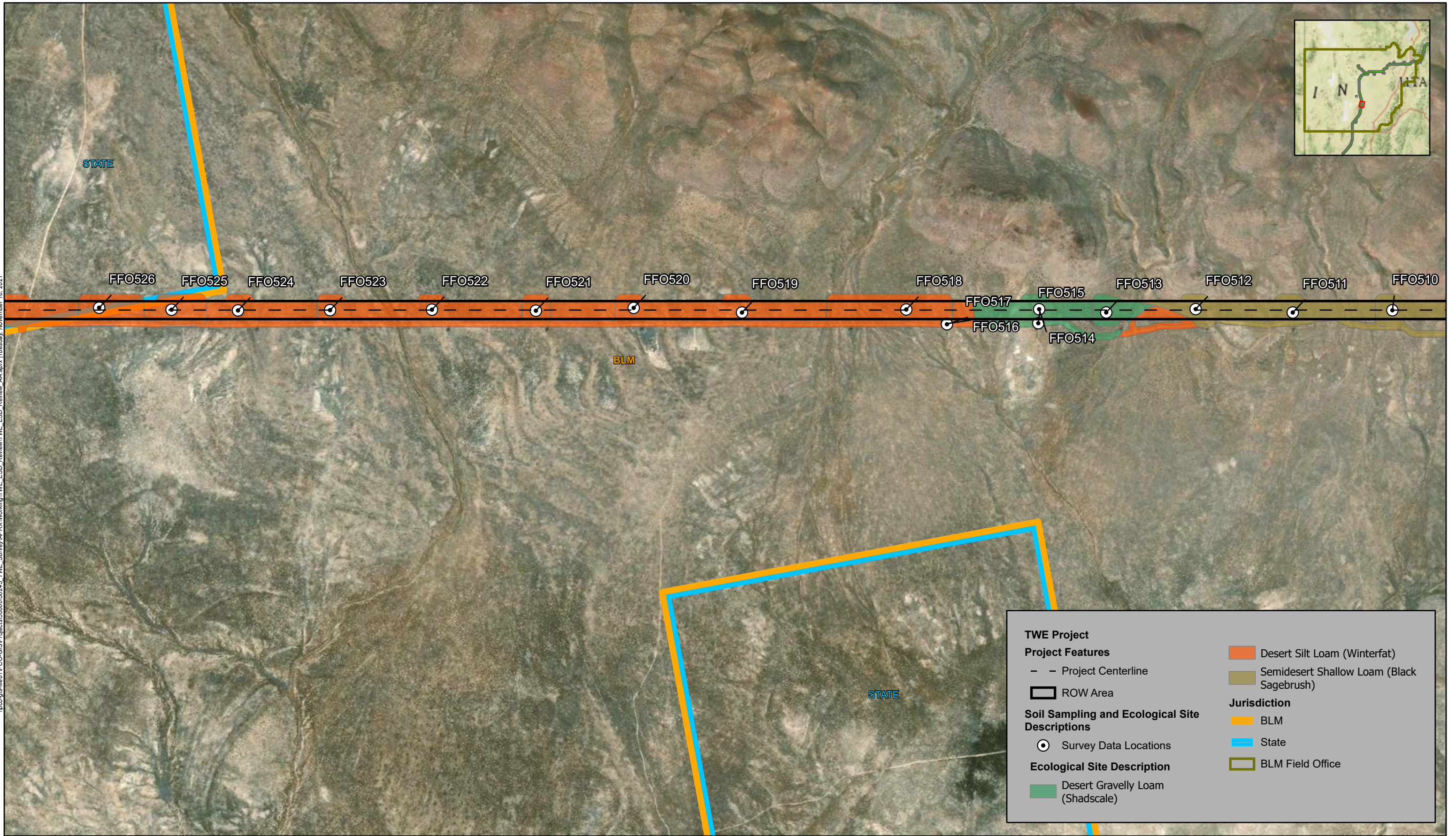
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Source: BLM 2015

Map 32 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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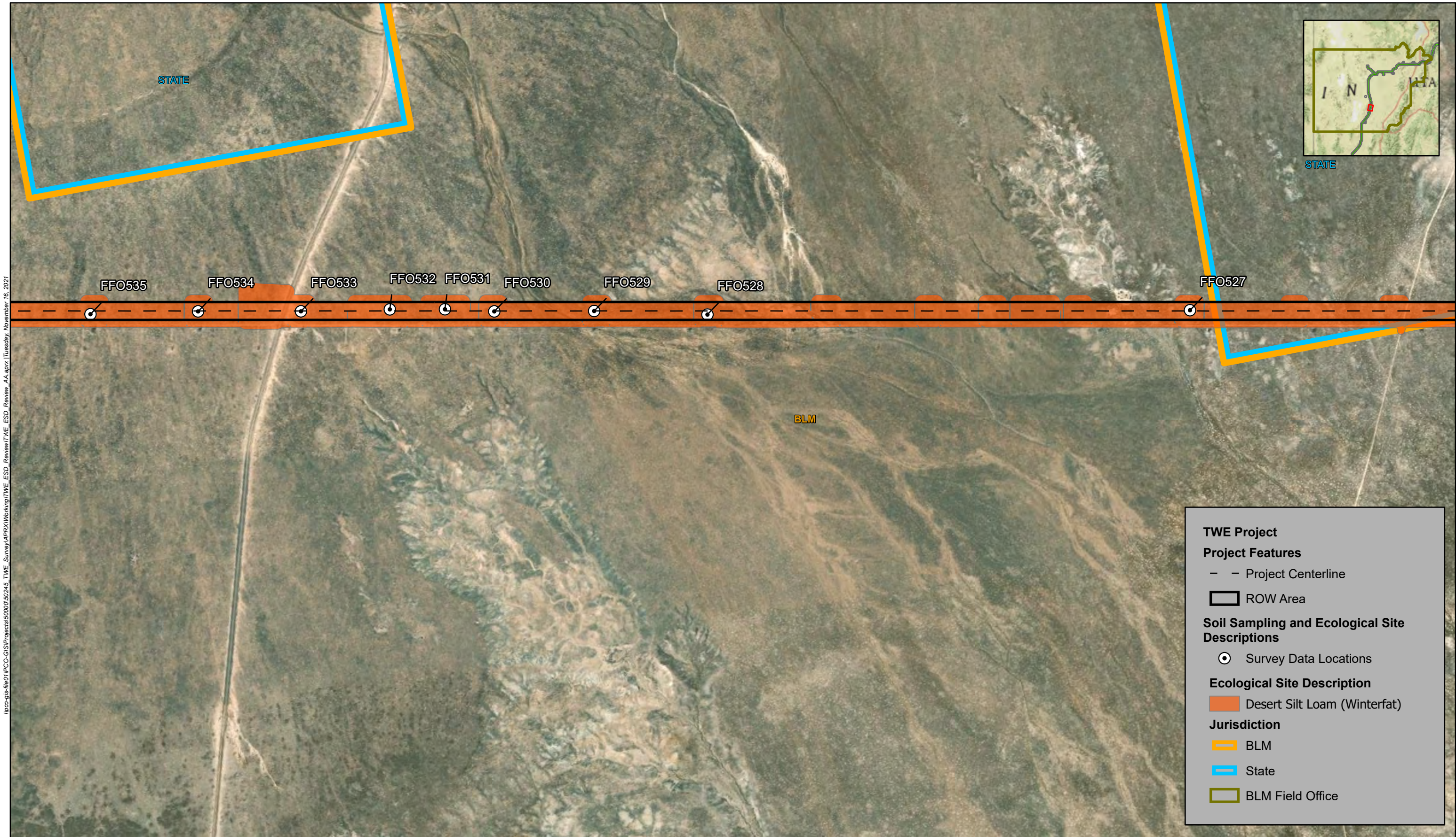
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Project Design Date: 08/30/2021
Source: BLM 2015

Map 33 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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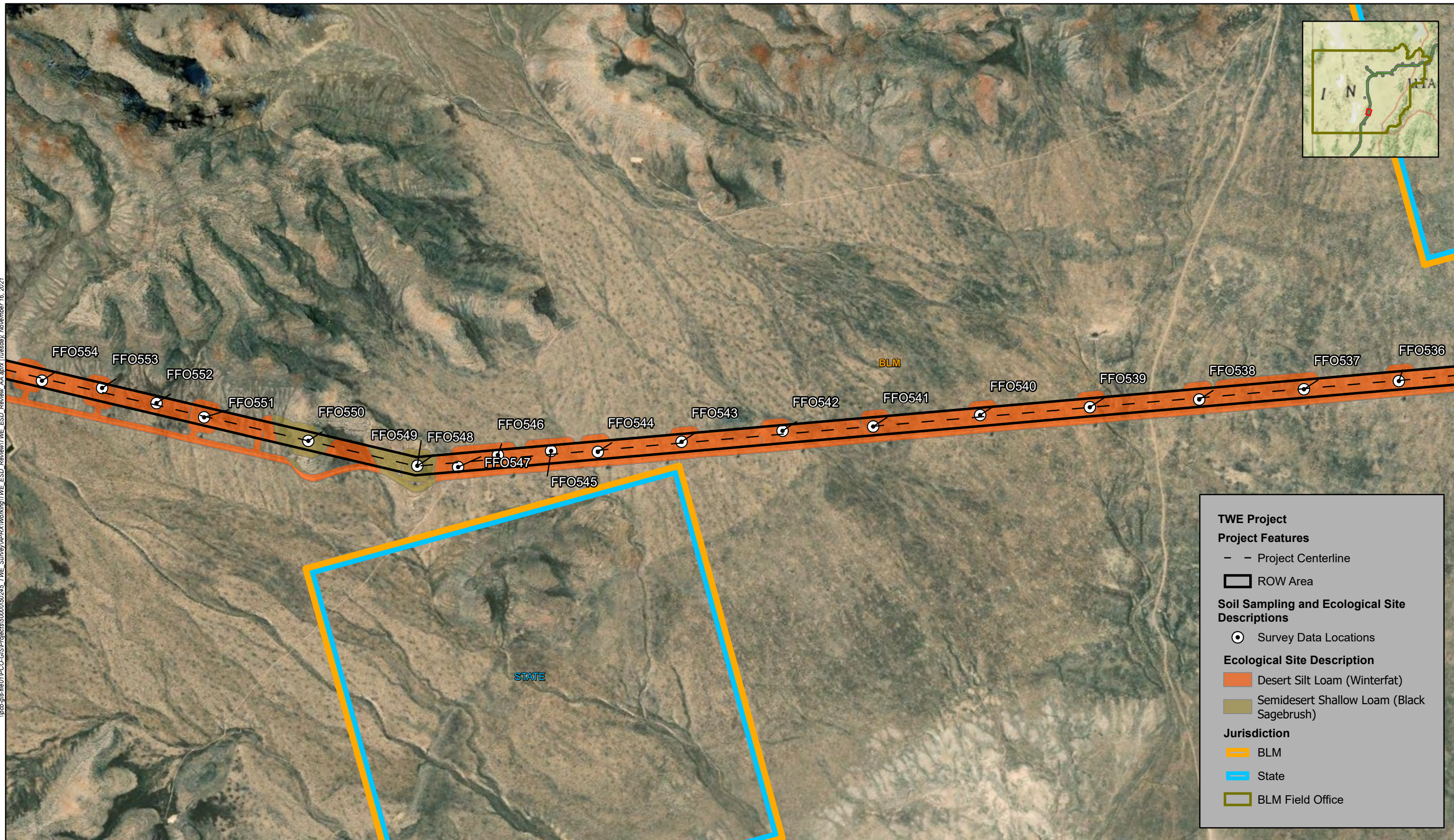
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Project Design Date: 08/30/2021
Source: BLM 2015

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Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- ⊙ Survey Data Locations

Ecological Site Description

- ▭ Desert Silt Loam (Winterfat)
- ▭ Semidesert Shallow Loam (Black Sagebrush)

Jurisdiction

- ▭ BLM
- ▭ State
- ▭ BLM Field Office



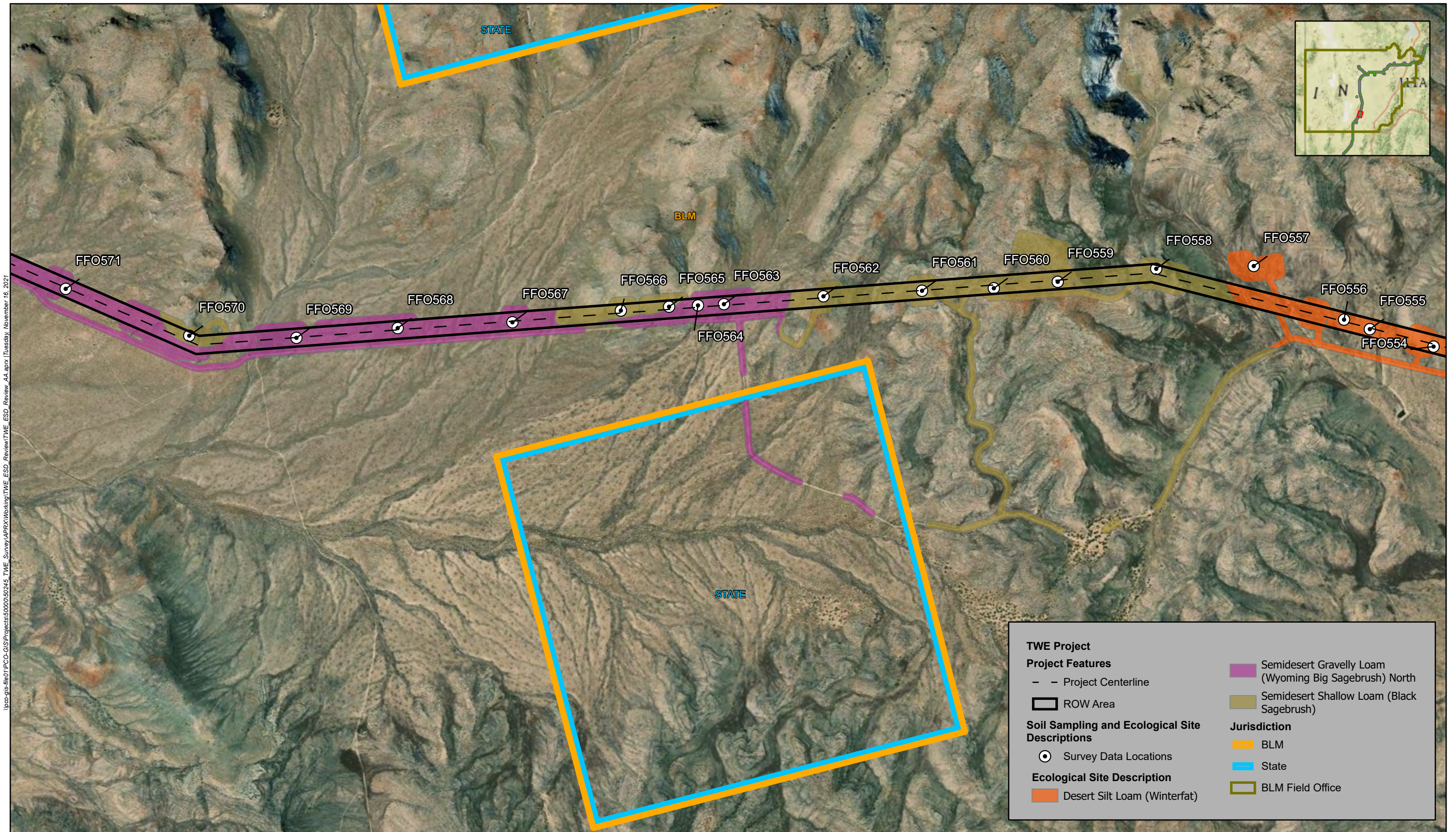
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Feet
Project Design Date: 08/30/2021
Source: BLM 2015

Map 35 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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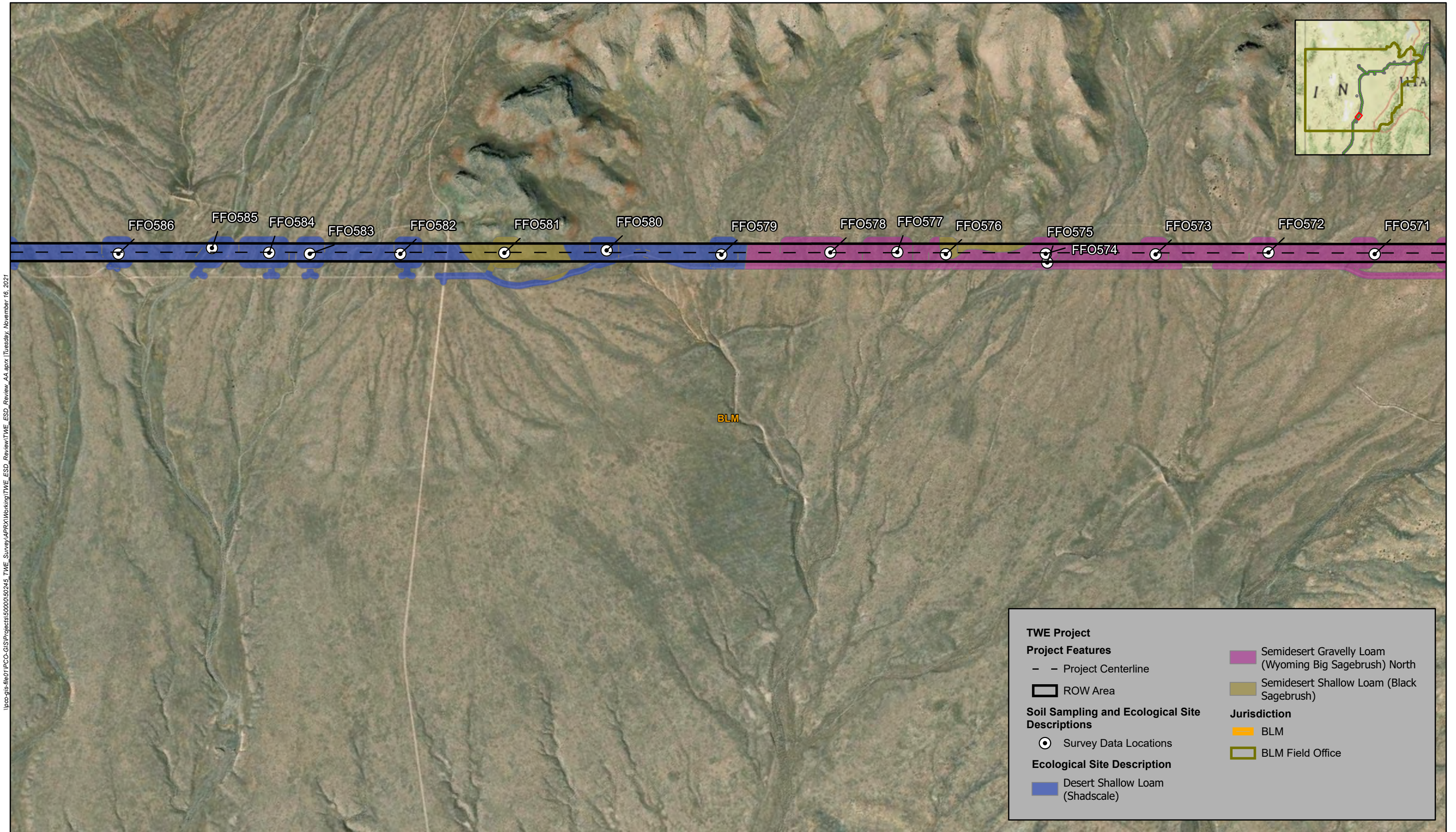
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Project Design Date: 08/30/2021
Source: BLM 2015

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Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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Feet

Project Design Date: 08/30/2021
Source: BLM 2015

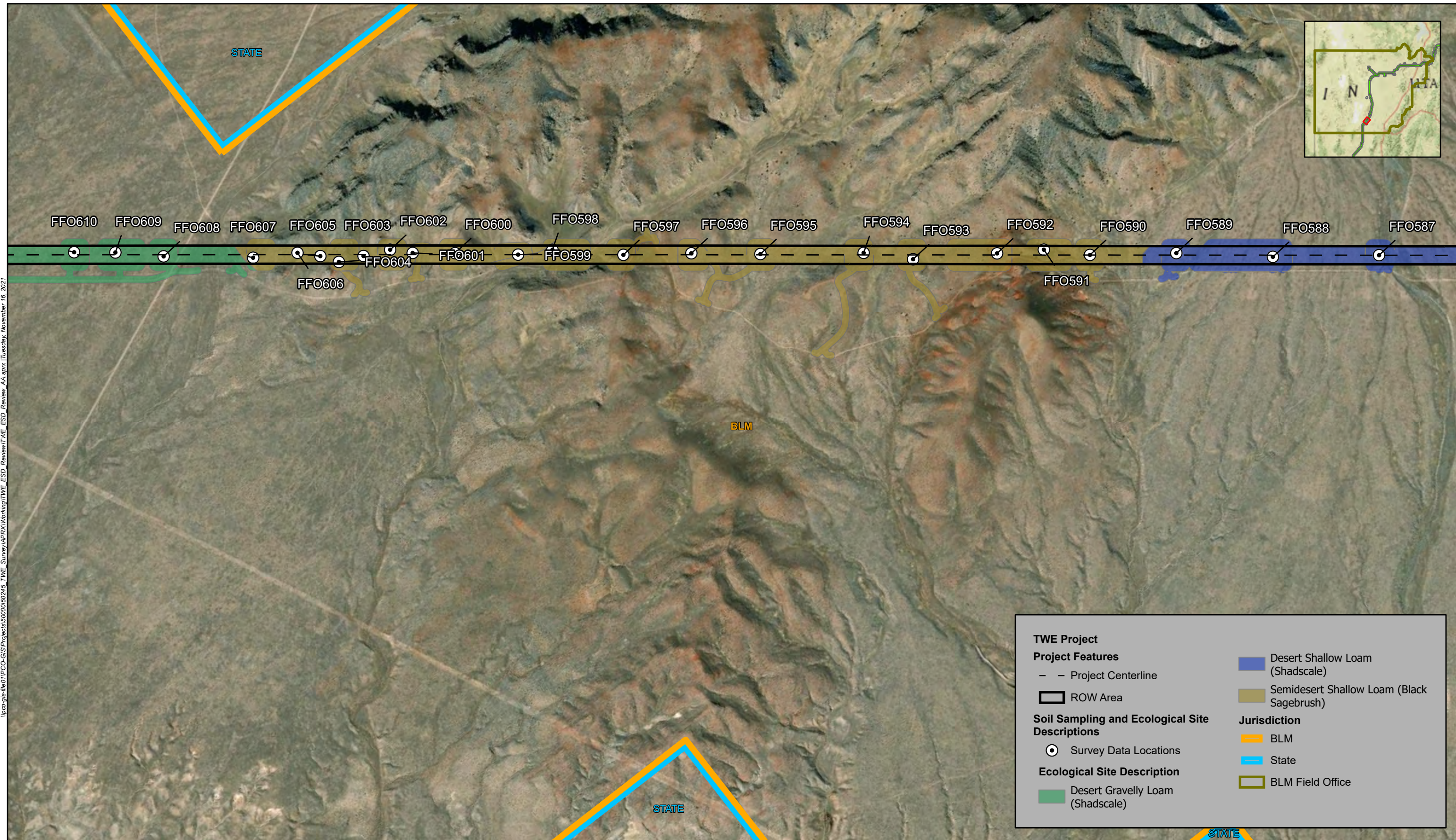
Map 37 of 42

Ecological Site Descriptions- Fillmore Field Office

TransWest Express Transmission Project



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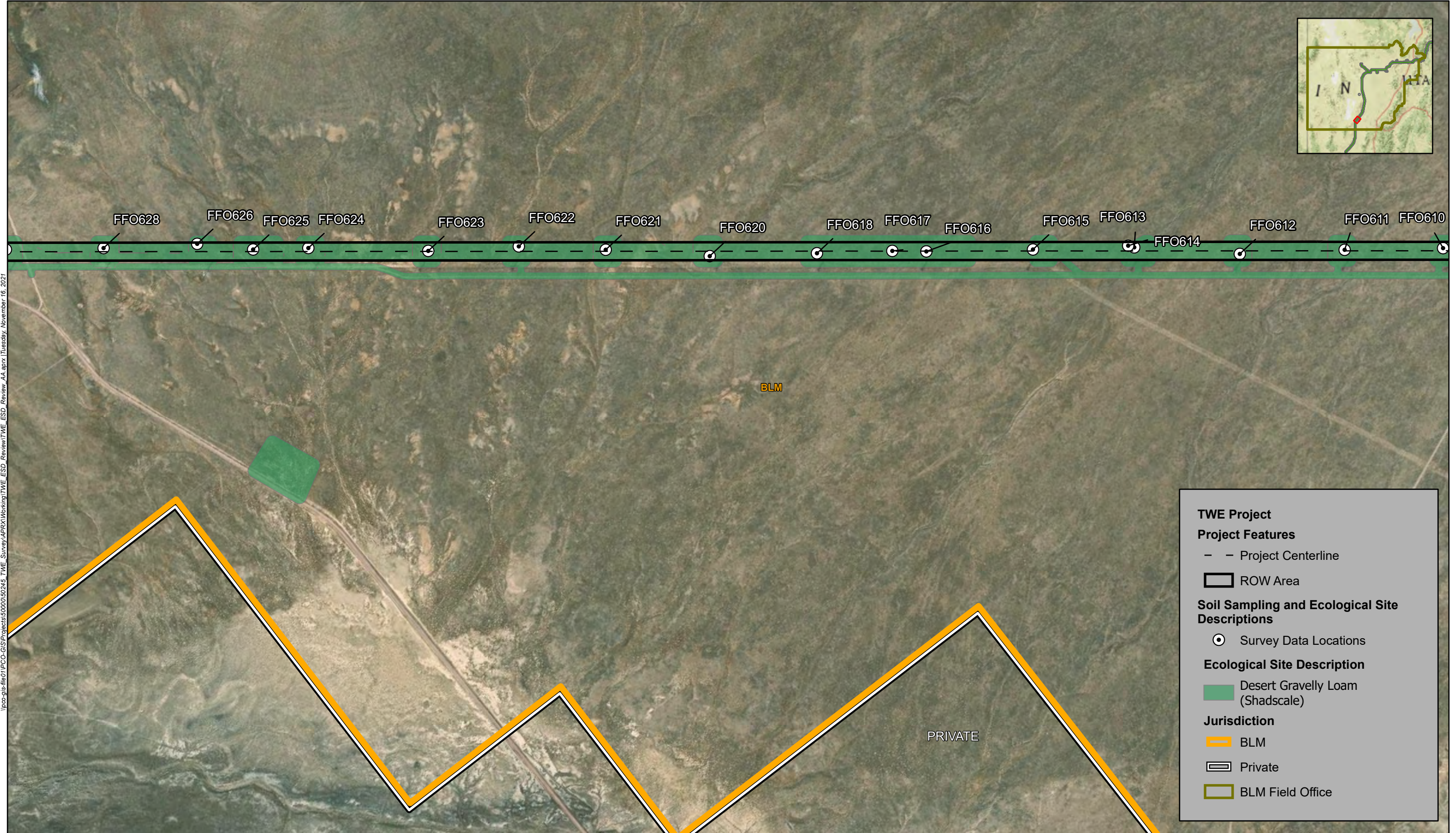
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Source: BLM 2015

Map 38 of 42

Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



\\pcc-gis-file01\PCOG-GIS\Projects\50000\50245_TWE_Survey\APRX\Working\TWE_ESD_Review\TWE_ESD_Review_A4.aprx [Tuesday, November 16, 2021]



TWE Project

Project Features

- -

Project Centerline

ROW Area

Soil Sampling and Ecological Site Descriptions

Survey Data Locations

Ecological Site Description

Desert Gravelly Loam (Shadscale)

Jurisdiction

BLM

Private

BLM Field Office

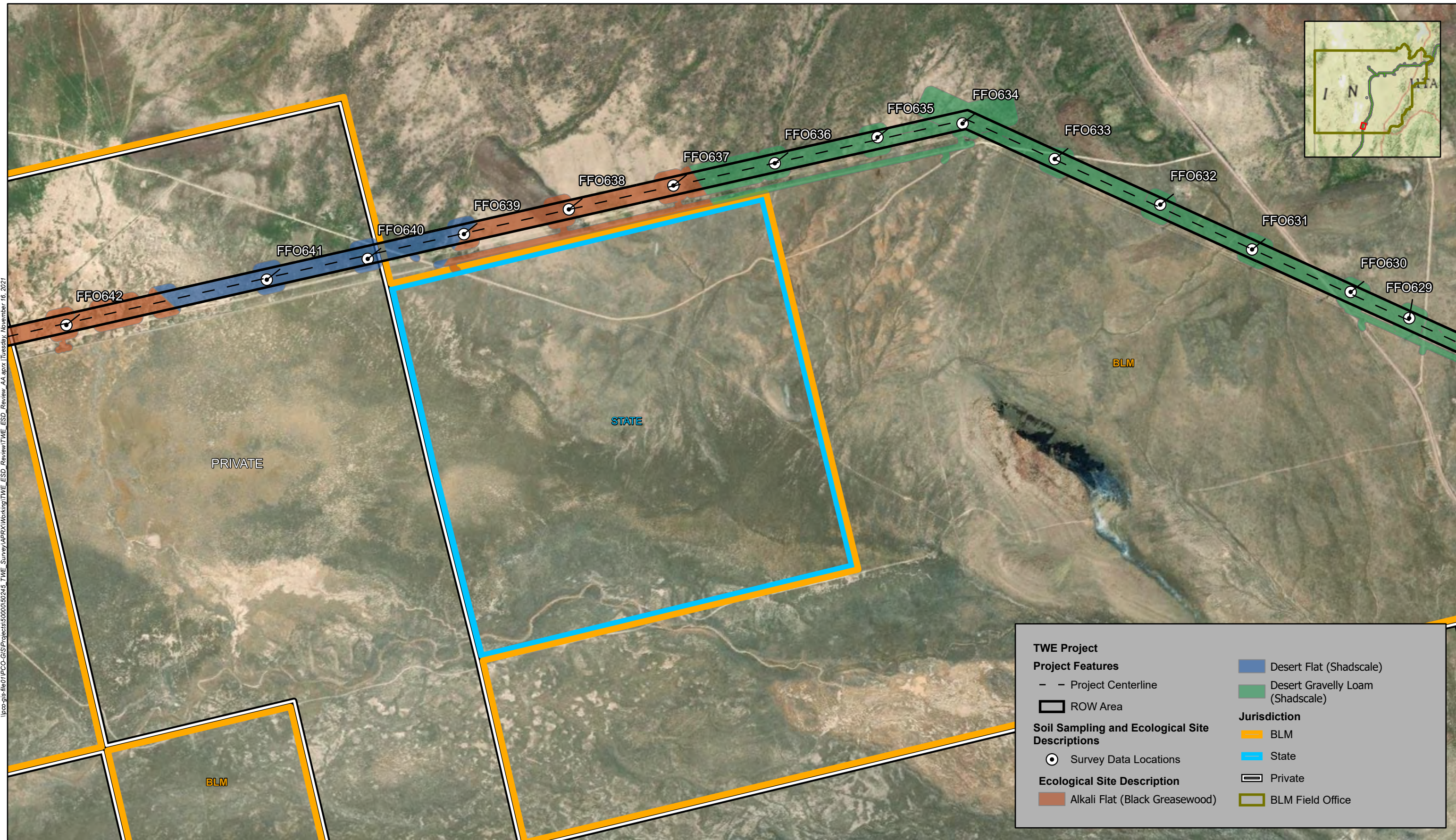
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Project Design Date: 08/30/2021

Source: BLM 2015

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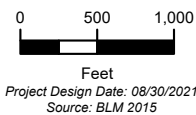
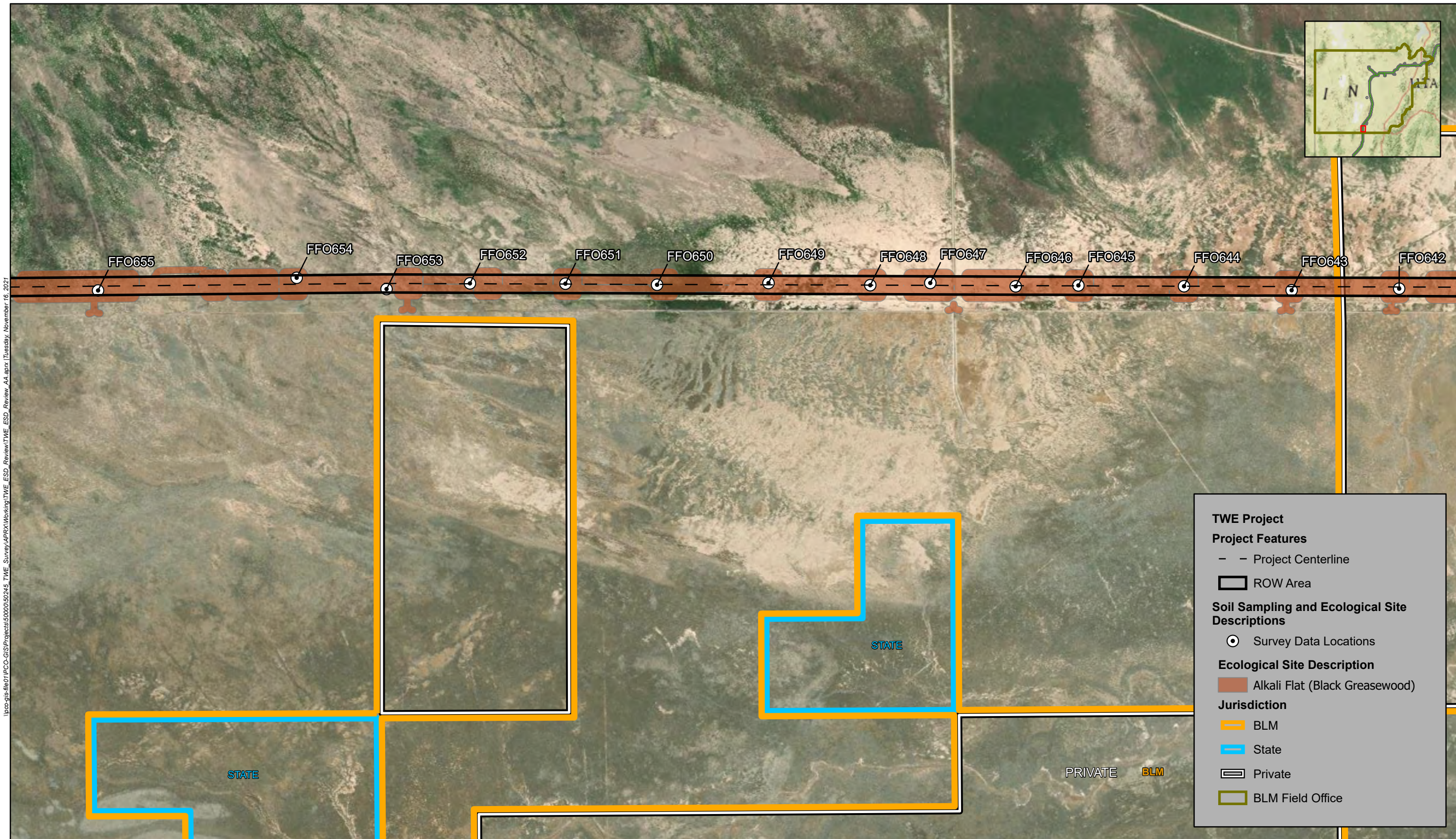
Project Design Date: 08/30/2021
Source: BLM 2015

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Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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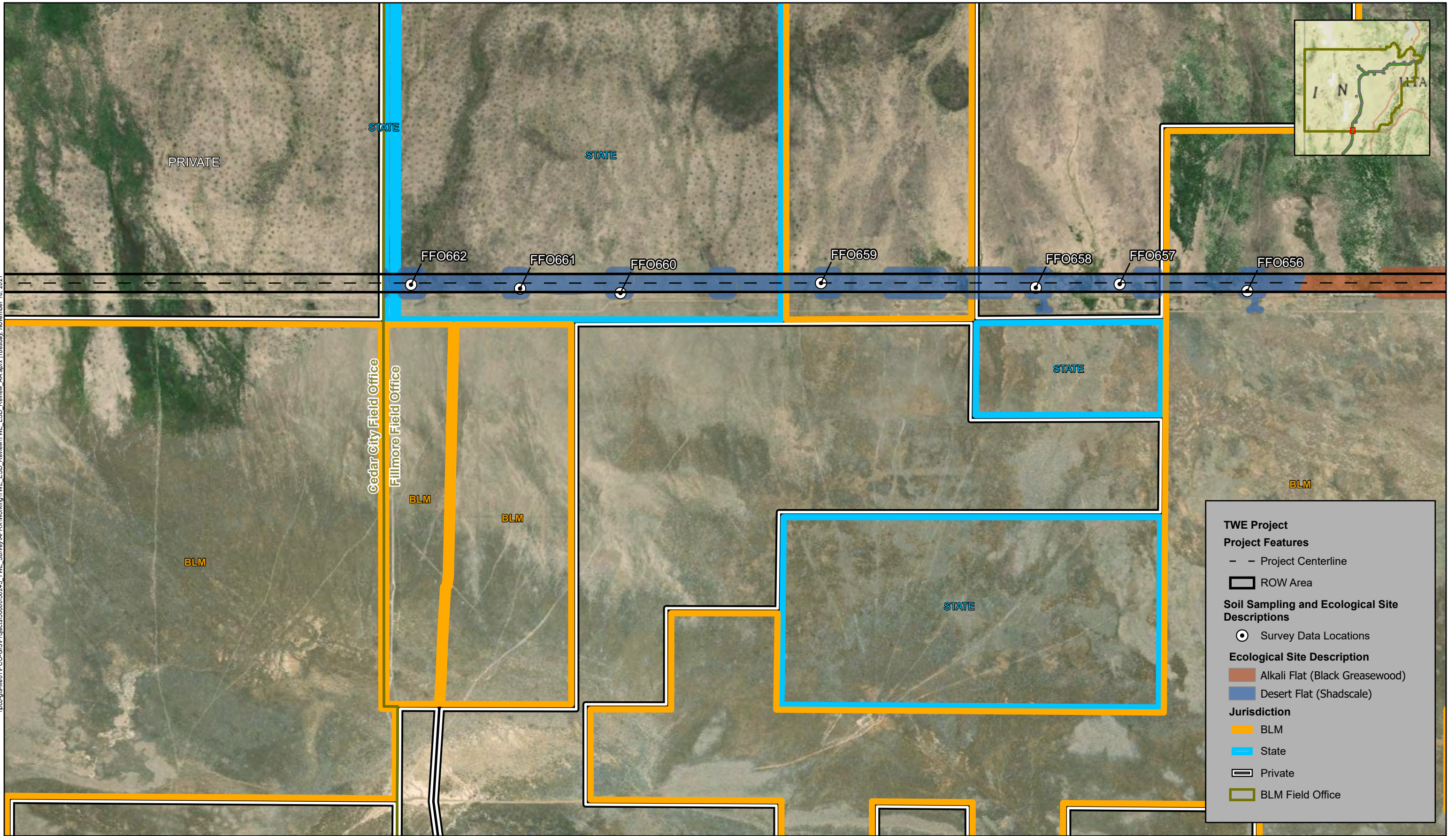


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Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



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Project Design Date: 08/30/2021
Source: BLM 2015

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Ecological Site Descriptions- Fillmore Field Office
TransWest Express Transmission Project



APPENDIX G

Cedar City Field Office Ecological Site Descriptions

1.0 ENVIRONMENTAL SETTINGS

1.1 Great Salt Lake Area Major Land Resource Area

In Utah, the TransWest Express Transmission Project (TWE Project) is in the Great Salt Lake Area Major Land Resource Area (MLRA) (MLRA-28A). Elevation ranges from 3,950 to 6,560 feet (1,205 to 2,000 meters) in the basins and from 6,560 to 11,150 feet (2,000 to 3,400 meters) in the mountains. The average annual precipitation is 5 to 12 inches (125 to 305 millimeters) in the valleys and is as much as 49 inches (1,245 millimeters) in the mountains. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The driest period is from midsummer to early autumn. Precipitation in winter typically occurs as snow. The average annual temperature is 39 degrees Fahrenheit (°F) to 53°F (4 to 12 degrees Celsius). The frost-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with elevation. Water is scarce in this region. For the most part, streams are small and intermittent and depend on sources in the higher mountains. Reservoirs are used to store water in the mountains east of this area for irrigation in the flatter areas of this MLRA.

The dominant soil orders in the MLRA are Aridisols, Entisols, and Mollisols. The soils in the MLRA dominantly have a mesic or frigid soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are well drained or somewhat excessively drained, loamy or loamy-skeletal, and very deep. Calcixerolls formed in alluvium on alluvial fan remnants and lake terraces (Abela series) and in alluvium and lacustrine sediments on lake terraces (Collinston series). Moderately deep Haploxerolls (Middle series) formed in residuum on mountain slopes. Deep and very deep Haploxerolls (Ririe and Rexburg series) formed in loess and silty alluvium on fans, terraces, foothills, and basalt plains. Shallow Haploxerolls (Hymas series) to very deep Haploxerolls (Hondoho series) formed in colluvium and residuum derived from limestone on mountains and foothills. Torriorthents formed in alluvium on alluvial fans and beach plains (Cliffdown series) and in alluvium mixed with lacustrine sediments on alluvial flats and fans, lake terraces, and lake plains (Timpie and Tooele series). Poorly drained Aquisalids (Saltair series) formed in alluvium and lacustrine sediments on lake plains and basin floors. Torripsamments (Yenrab series) formed in sandy eolian material on dunes. Haplocalcids formed in residuum on hills and mountains (shallow Amtoft series); in alluvium and colluvium on alluvial fans, terraces, and hills (Hiko Peak series); in mixed alluvium and lacustrine sediments on alluvial fans, terraces; and lake plains (Taylorsflat series); and in lacustrine sediments on lake terraces (Thiokol series). Natrargids (Skumpah series) formed in alluvium on alluvial fans and flats.

This area supports desert shrub, Sagebrush Semidesert, and woodland vegetation. In areas where the average annual precipitation is less than about 200 millimeters, the soils support shadscale saltbush (*Atriplex confertifolia*), winterfat (*Krascheninnikovia lanata*), black sagebrush (*Artemisia nova*), and associated grasses, such as Indian ricegrass (*Achnatherum hymenoides*) and squirreltail (*Elymus elymoides*). Greasewood (*Sarcobatus vermiculatus*) and Nuttall's saltbush (*Atriplex nuttallii*) grow on soils having a high content of salts or sodium. In areas where the average annual precipitation is 200 to 300 millimeters, the soils support big sagebrush (*Artemisia tridentata*), shadscale saltbush, winterfat, and associated grasses, such as bluebunch wheatgrass (*Pseudoroegneria spicata*), Indian ricegrass, and bluegrasses (*Poa* spp.). In areas where the average annual precipitation is more than 300 millimeters, the soils support Utah juniper (*Juniperus osteosperma*), singleleaf pinyon (*Pinus monophylla*), big sagebrush, bluebunch wheatgrass, bluegrasses, and needle and thread (*Hesperostipa comata*). A large, nearly barren area west of Great Salt Lake has a very sparse cover of pickleweed (*Salicornia* spp.), sapphire woollystar (*Eriastrum saphirinum*), seepweed (*Suaeda* spp.), and greasewood.

1.2 Ecological Site Distribution

Dominant ecological sites in the TWE Project right-of-way within the Cedar City Field Office (FO) include Semidesert Loam (Wyoming Big Sagebrush) (492.9) and Semidesert Sandy Loam (Winterfat) (380.4 acres). Less prevalent ecological sites include Semidesert Sand (Fourwing Saltbush) (34.2 acres) and Semidesert Shallow Hardpan (Black Sagebrush) (27.0 acres). All ecological sites are located within BLM managed lands (Table G-1). A photograph of each ecological site is provided in Attachment G-1. Maps depicting the ecological site locations in the TWE Project right-of-way are provided in Attachment G-2.

TABLE G-1 ECOLOGICAL SITE DISTRIBUTION IN THE BLM CEDAR CITY FO

Ecological Site	Managing Agency	Right-of-Way Area (acres)	Permanent Disturbance Area (acres)	Temporary Work Area (acres)
Alkali Flats		73	1	40
Alkali Flat (Black Greasewood)	BLM	27	1	10
Desert Alkali Sandy Loam (Shadscale)	BLM	0	0	0
Desert Flat (Shadscale)	BLM	14	<1	16
Semidesert Alkali Loam (Black Greasewood)	BLM	32	1	14
Sands		12	<1	9
Semidesert Sand (Fourwing Saltbush)	BLM	12	<1	9
Semidesert Loams		637	14	375
Semidesert Loam (Wyoming Big Sagebrush)	BLM	258	5	152
Semidesert Sandy Loam (Winterfat)	BLM	249	5	135
Semidesert Sandy Loam (Wyoming Big Sagebrush)	BLM	105	2	69
Semidesert Shallow Hardpan (Black Sagebrush)	BLM	25	1	18
Other*		44	1	30

* Other ecological sites include human modified sites (e.g., 'Agriculture and Pasture', 'Disturbed and Developed', 'Invasive Annual Grassland, etc.)

1.3 Rangeland Analysis Platform

RAP was used to further assess the distribution and estimated cover of vegetation and cover types across the Project (NRCS and BLM 2021). RAP integrates data from NRCS's National Resources Inventory and BLM's Assessment, Inventory, and Monitoring and Landscape Monitoring Framework datasets. These quantitative vegetative assessments are modeled with historical Landsat satellite records, gridded meteorology data, and abiotic land surface data to provide estimates of the percent vegetation cover of different growth forms. RAP data were used to define the vegetation and abiotic characteristics for the Project and to develop reclamation success cover standards for each ecological site and DRG, as defined in Table G-2.

TABLE G-2 DRG RAP ATTRIBUTE DATA FOR THE BLM CEDAR CITY FO

DRG	ESD	Forbs and Grasses - Annuals (%)	Forbs and Grasses - Perennial (%)	Woody (%)	Litter (%)	Bareground (%)
Alkali Flats	Alkali Flat	6.1	5.1	12.5	11.0	58.3
	Desert Alkali Sandy Loam	11.5	7.5	15.3	14.6	39.8
	Desert Flat	8.5	6.7	16.8	13.2	46.2
	Semidesert Alkali Loam	4.5	4.7	19.3	12.0	50.2
	SUBTOTAL	7.6	6.0	16.0	12.7	48.6
Sands	Semidesert Sand	14.5	10.3	11.1	16.0	44.6
	SUBTOTAL	14.5	10.3	11.1	16.0	44.6
Semidesert Loams	Semidesert Loam	7.7	7.9	20.3	13.6	35.2
	Semidesert Sandy Loam - Wyoming Big Sagebrush	9.4	7.3	13.4	12.9	49.0
	Semidesert Sandy Loam - Winterfat	17.3	9.7	13.5	15.6	31.5
	Semidesert Shallow Hardpan	22.4	6.5	14.4	14.5	22.2
	SUBTOTAL	14.2	7.9	15.4	14.1	34.5

Source: NRCS and BLM 2021

2.0 INDIVIDUAL ECOLOGICAL SITE DESCRIPTIONS

2.1 Semidesert Alkali Loam (Black Greasewood) Ecological Site Description

Semidesert Alkali Loam (Black Greasewood) ecological sites in the TWE Project within the Cedar City FO occur on lake fans and fan terraces on slopes ranging from 0% to 5% (Natural Resources Conservation Service [NRCS] 2011). Major soil series associated with Semidesert Alkali Loam (Black Greasewood) ecological sites include Biblesprings, Manselo, Mellor, Woodrow, Manassa, Medburn, and Taylorsflat. The climate in Semidesert Alkali Loam (Black Greasewood) ecological sites is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges from 8 to 12 inches. Annual distribution of precipitation varies during the wet and dry season. On average, 70% of the precipitation falls as rain during March through October. On average, June through September are the driest months and March through May are the wettest months.

2.1.1 Soil Characteristics

Semidesert Alkali Loam (Black Greasewood) ecological sites are characterized by moderately deep soils that are well drained with moderately slow to moderate permeability and low runoff potential (Table G-3; NRCS 2020a). Topsoil textures range from sandy loam to silty clay loam and average depth is approximately 6.20 ± 2.21 inches. Subsoil textures are characterized by loam to silty clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity (electrical conductivity [EC] > 4.0 deciSiemens per meter [dS/m]), and sodicity (sodium adsorption ratio [SAR] > 12.0) may limit vegetation growth in some areas (see Table G-3).

TABLE G-3 SOIL CHARACTERISTICS TYPICAL OF SEMIDESERT ALKALI LOAM (BLACK GREASEWOOD) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium derived from sedimentary (sandstone and shale) and igneous rocks
Topsoil depth	6.20 ± 2.21 inches
Topsoil texture	Sandy loam to silty clay loam
Topsoil fragments	5%–15% gravel
Topsoil pH	8.2–8.6
Topsoil salinity (EC)	0–8 dS/m
Topsoil sodicity (SAR)	0–13
Subsoil texture	Loam to silty clay loam
Subsoil fragments	5%–25% gravel
Subsoil pH	8.4–9.6
Subsoil salinity (EC)	0–8 dS/m
Subsoil sodicity (SAR)	0–13

Source: NRCS (2020a, 2020d)

2.1.2 Vegetation

Vegetative composition by growth forms in Semidesert Alkali Loam (Black Greasewood) ecological sites is approximately 35% grasses, 5% forbs, 50% shrubs (Table G-4; NRCS 2020a). The dominant grasses that may occur in Semidesert Alkali Loam (Black Greasewood) ecological sites include squirreltail, Sandberg bluegrass (*Poa secunda*), and Indian ricegrass (NRCS 2020a). Other grasses and grass-like plants that may occur include basin wildrye (*Leymus cinereus*), western wheatgrass (*Pascopyrum smithii*), James' galleta (*Pleuraphis jamesii*), and sand dropseed (*Sporobolus cryptandrus*). Greasewood is the major woody plant. Other woody plants that may occur include Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*).

TABLE G-4 VEGETATION CHARACTERISTICS TYPICAL SEMIDESERT ALKALI LOAM (BLACK GREASEWOOD) ECOLOGICAL SITES

Growth Form	Composition
Grasses	35%
Forbs	5%
Shrubs	50%

Source: NRCS (2020a)

2.2 Alkali Flat (Black Greasewood) Ecological Site Description

Alkali Flat (Black Greasewood) ecological sites in the TWE Project within the Cedar City FO occur on lake plains, floodplains, alluvial flats, fan remnants, and lake terraces on slopes ranging from 0% to 5% (NRCS 2020a). Major soil series associated with Alkali Flat (Black Greasewood) ecological sites include Antelope Springs, Bullion, Uvada, and Woodrow. The climate in Alkali Flat (Black Greasewood) ecological sites is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges from 8 to 12 inches. Annual distribution of precipitation varies during the wet and dry season. The most reliable sources of moisture are snow that accumulates over the winter and rains during spring.

2.2.1 Soil Characteristics

Alkali Flat (Black Greasewood) ecological sites are characterized by moderately deep soils that are well drained with moderately slow to moderate permeability and low to medium runoff potential (Table G-5; NRCS 2020a). Topsoil textures range from silt loam to silty clay loam and average depth is approximately 6.80 ± 3.59 inches. Subsoil textures are characterized by silty clay loam to silty clay (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table G-5).

TABLE G-5 SOIL CHARACTERISTICS TYPICAL OF ALKALI FLAT (BLACK GREASEWOOD) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium derived from sedimentary (sandstone and shale) and igneous rocks
Topsoil depth	6.80 ± 3.59 inches
Topsoil texture	Silt loam to silty clay loam
Topsoil fragments	—
Topsoil pH	8.3–9.2
Topsoil salinity (EC)	4–16 dS/m
Topsoil sodicity (SAR)	5–30
Subsoil texture	Silty clay loam to silty clay
Subsoil fragments	—
Subsoil pH	8.4–9.4
Subsoil salinity (EC)	4–16 dS/m
Subsoil sodicity (SAR)	25–40

Sources: NRCS (2020a, 2020d)

2.2.2 Vegetation

Vegetative composition by growth forms in Alkali Flat (Black Greasewood) ecological sites is approximately 20% grasses, 10% forbs, and 70% shrubs (Table G-6; NRCS 2020a). The dominant grass species that may occur in Alkali Flat (Black Greasewood) ecological sites is squirreltail (NRCS 2020a). Other grasses that may occur include Indian ricegrass, low woollygrass (*Dasyochloa pulchella*), saltgrass (*Distichlis spicata*), basin wildrye, western wheatgrass, Sandberg bluegrass, and alkali sacaton (*Sporobolus airoides*). Greasewood is the major woody plant. Other woody plants that may occur include shadscale saltbush.

TABLE G-6 VEGETATION CHARACTERISTICS TYPICAL OF ALKALI FLAT (BLACK GREASEWOOD) ECOLOGICAL SITES

Growth Form	Composition
Grasses	20%
Forbs	10%
Shrubs	70%

Source: NRCS (2020a)

2.3 Desert Alkali Sandy Loam (Shadscale) Ecological Site Description

Desert Alkali Sandy Loam (Shadscale) ecological sites in the TWE Project within the Cedar City FO occur on valley floodplains and low alluvial fans (NRCS 2020a). Major soil series associated with Desert Alkali Sandy Loam (Shadscale) ecological sites include Escalante and Taylorsflat. The climate in Desert Alkali Sandy Loam (Shadscale) ecological sites is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges from 8 to 12 inches. Annual distribution of precipitation varies during the wet and dry season. On average, 70% of the precipitation falls as rain during March through October. On average, June through September are the driest months and March through May are the wettest months.

2.3.1 Soil Characteristics

Desert Alkali Sandy Loam (Shadscale) ecological sites are characterized by moderately deep soils that are well drained with moderately slow to moderate permeability and low runoff potential (Table G-7; NRCS 2020a). Topsoil textures range from loam to sandy loam and average depth is approximately 8.0 ± 6.0 inches. Subsoil textures are characterized by loam to loamy fine sand. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table G-7).

TABLE G-7 SOIL CHARACTERISTICS TYPICAL OF DESERT ALKALI SANDY LOAM (SHADSCALE) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium derived from sedimentary (sandstone and shale) and igneous rocks
Topsoil depth	8.0 ± 6.0 inches
Topsoil texture	Loam to sandy loam
Topsoil fragments	—
Topsoil pH	7.8–8.3
Topsoil salinity (EC)	0–4 dS/m
Topsoil sodicity (SAR)	—
Subsoil texture	Loam to loamy fine sand
Subsoil fragments	15%–35% gravel
Subsoil pH	8.2–8.6
Subsoil salinity (EC)	0–4 dS/m
Subsoil sodicity (SAR)	—

Sources: NRCS (2020a, 2020d)

2.3.2 Vegetation

Vegetative composition by growth forms in Desert Alkali Sandy Loam (Shadscale) ecological sites is approximately 75% grasses, 5% forbs, and 20% shrubs (Table G-8; NRCS 2020a). The dominant grasses that may occur in Desert Alkali Sandy Loam (Shadscale) ecological sites include alkali sacaton, Indian ricegrass, squirreltail, western wheatgrass, and James' galleta (NRCS 2020a). Other grasses and grass-like plants that may occur include purple threeawn (*Aristida purpurea*), saltgrass, and sand dropseed. Greasewood is the major woody plant. Other woody plants that may occur are basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and rubber rabbitbrush (*Ericameria nauseosa*) (NRCS 2020a).

TABLE G-8 VEGETATION CHARACTERISTICS TYPICAL OF LOAMY 7–9 INCH ECOLOGICAL SITES

Growth Form	Composition
Grasses	75%
Forbs	5%
Shrubs	20%

Source: NRCS (2020a)

2.4 Desert Flat (Shadscale) Ecological Site Description

Desert Flat (Shadscale) ecological sites in the TWE Project within the Cedar City FO occur on lake plains and lake terraces on low slopes (NRCS 2020a). Major soil series associated with Desert Flat (Shadscale) ecological sites include Bullion, Drum, Hiko Springs, Skumpah, and Woodrow. The climate in Desert Flat (Shadscale) ecological sites is characterized by cold, snowy winters and warm, dry summers.

The average annual precipitation ranges from 5 to 8 inches. Annual distribution of precipitation varies during the wet and dry season. On average, 70% of the precipitation falls as rain during March through October. On average, June through September are the driest months and March through May are the wettest months.

2.4.1 Soil Characteristics

Desert Flat (Shadscale) ecological sites are characterized by moderately deep soils that are well drained with moderately slow to moderate permeability and low to medium runoff potential (Table G-9; NRCS 2020a). Topsoil textures range from silt loam to silty clay loam and average depth is approximately 6.20 ± 3.12 inches. Subsoil textures are characterized by silty clay loam to clay loam (NRCS 2020a). Subsoil texture is loamy. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table G-9).

TABLE G-9 SOIL CHARACTERISTICS TYPICAL OF DESERT FLAT (SHADSCALE) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium derived from sedimentary (sandstone and shale) and igneous rocks
Topsoil depth	6.20 ± 3.12 inches
Topsoil texture	Silt loam to silty clay loam
Topsoil fragments	15% gravel
Topsoil pH	8.3–9.2
Topsoil salinity (EC)	2–16 dS/m
Topsoil sodicity (SAR)	5–30
Subsoil texture	Silty clay loam to clay loam
Subsoil fragments	0%–35% gravel
Subsoil pH	8.4–9.4
Subsoil salinity (EC)	2–32 dS/m
Subsoil sodicity (SAR)	5–30

Sources: NRCS (2020a, 2020d)

2.4.2 Vegetation

Vegetative composition by growth forms in Desert Flat (Shadscale) ecological sites is approximately 80% shrubs and a low cover of grasses (Table G-10; NRCS 2020a). The dominant grasses that may occur in Desert Flat (Shadscale) ecological sites include squirreltail and Indian ricegrass (NRCS 2020a). Other grasses that may occur include James' galleta (*Hilaria jamesii*) and Sandberg bluegrass. Shadscale saltbush is the major woody plant. Other woody plants that may occur include bud sagebrush (*Picrothamnus desertorum*), and green molly (*Kochia americana*) (NRCS 2020a).

TABLE G-10 VEGETATION CHARACTERISTICS TYPICAL OF DESERT FLAT (SHADSCALE) ECOLOGICAL SITES

Growth Form	Composition
Grasses	–
Forbs	–
Shrubs	80%

Source: NRCS (2020a)

2.5 Semidesert Sand (Fourwing Saltbush) Ecological Site Description

Semidesert Sand (Fourwing Saltbush) ecological sites in the TWE Project within the Cedar City FO occur on dunes, lake terraces, alluvial fans, fan terraces, and lake plains on slopes ranging between 0% and 10% (NRCS 2020a). The major soil series associated with Semidesert Sand (Fourwing Saltbush) ecological sites is Berent. The climate in Semidesert Sand (Fourwing Saltbush) ecological sites is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges from 9 to 13 inches. Annual distribution of precipitation varies during the wet and dry season. On average, March, April, and May are the wettest months and June, July, and August are the driest months.

2.5.1 Soil Characteristics

Semidesert Sand (Fourwing Saltbush) ecological sites are characterized by moderately deep soils that are somewhat excessively drained with rapid to very rapid permeability and slow runoff potential (Table G-11; NRCS 2020a). Topsoil has a loamy fine sand texture and depth is approximately 6.0 inches. Subsoils are characterized by fine sand textures. Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table G-11).

TABLE G-11 SOIL CHARACTERISTICS TYPICAL OF SEMIDESERT SAND (FOURWING SALTBUH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Eolian sands derived from lacustrine deposits on stabilized sand dunes
Topsoil depth	6.0 inches
Topsoil texture	Loamy fine sand
Topsoil fragments	–
Topsoil pH	8.0
Topsoil salinity (EC)	0–8 dS/m
Topsoil sodicity (SAR)	0–30
Subsoil texture	Fine sand
Subsoil fragments	–

Soil Characteristics	Description
Subsoil pH	8.2–8.8
Subsoil salinity (EC)	0–8 dS/m
Subsoil sodicity (SAR)	0–30

Sources: NRCS (2020a, 2020d)

2.5.2 Vegetation

Vegetative composition by growth forms in Semidesert Sand (Fourwing Saltbush) ecological sites is approximately 55% grasses, 5% forbs, and 40% shrubs (Table G-12; NRCS 2020a). The dominant grasses that may occur in Semidesert Sand (Fourwing Saltbush) ecological sites include Indian ricegrass, needle and thread, and James' galleta (NRCS 2020a). Other grasses and grass-like plants that may occur include purple threeawn, squirreltail, sandhill muhly (*Muhlenbergia pungens*), western wheatgrass, Sandberg bluegrass, alkali sacaton, and sand dropseed. Fourwing saltbush is the major woody plant. Other woody plants that may occur include slender buckwheat (*Eriogonum microthecum*), rubber rabbitbrush, and basin big sagebrush (NRCS 2020a).

TABLE G-12 VEGETATION CHARACTERISTICS TYPICAL OF SEMIDESERT SAND (FOUR-WING SALTBUH) ECOLOGICAL SITES.

Growth Form	Composition
Grasses	55%
Forbs	5%
Shrubs	40%

Source: NRCS (2020a)

2.6 Semidesert Loam (Wyoming Big Sagebrush) Ecological Site Description

Semidesert Loam (Wyoming Big Sagebrush) ecological sites in the TWE Project within the Cedar City FO occur on lake terraces, floodplains, alluvial flats, and fan remnants on slopes ranging from 0% to 8% (NRCS 2020a). Major soil series associated with Semidesert Loam (Wyoming Big Sagebrush) ecological sites include Ashdown, Bamos, Crestline, Deerlodge, Denmark, Garbo, and Manselo. The climate in Semidesert Loam (Wyoming Big Sagebrush) ecological sites is characterized by cold snowy winters and warm dry summers. The average annual precipitation ranges from 9 to 15 inches. Annual distribution of precipitation varies during the wet and dry season. On average, March, April, and May are the wettest months and June, July, and August are the driest months.

2.6.1 Soil Characteristics

Semidesert Loam (Wyoming Big Sagebrush) ecological sites are characterized by moderately deep soils that are well drained with moderately slow to moderate permeability and medium to low runoff potential (Table G-13; NRCS 2020a). Topsoil textures range from loam to gravelly sandy loam and average depth is approximately 6.40 ± 1.68 inches. Subsoil textures are characterized by loam to gravelly clay loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table G-13).

TABLE G-13 SOIL CHARACTERISTICS TYPICAL OF SEMIDESERT LOAM (WYOMING BIG SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium, residuum, and colluvium derived from sedimentary (sandstone and shale) and igneous rocks
Topsoil depth	6.40 ± 1.68 inches
Topsoil texture	Loam to gravelly sandy loam
Topsoil fragments	30% gravel and 5% cobbles
Topsoil pH	7.4–8.6
Topsoil salinity (EC)	0–4 dS/m
Topsoil sodicity (SAR)	0–10
Subsoil texture	Loam to gravelly clay loam
Subsoil fragments	5% cobbles and 35% gravel
Subsoil pH	7.0–9.0
Subsoil salinity (EC)	0–4 dS/m
Subsoil sodicity (SAR)	0–10

Sources: NRCS (2020a, 2020d)

2.6.2 Vegetation

Vegetative composition by growth forms in Semidesert Loam (Wyoming Big Sagebrush) ecological sites is approximately 45% grasses, 10% forbs, and 45% shrubs (Table G-14; NRCS 2020a). The dominant grasses that may occur in Semidesert Loam (Wyoming Big Sagebrush) ecological sites include bluebunch wheatgrass and Indian ricegrass (NRCS 2020a). Other grasses and grass-like plants that may occur include purple threeawn, blue grama, squirreltail, needle and thread, basin wildrye, western wheatgrass, James' galleta, muttongrass (*Poa fendleriana*), and Sandberg bluegrass. Wyoming big sagebrush is the major woody plant. Other woody plants that may occur include yellow rabbitbrush and Nevada jointfir (NRCS 2020a).

TABLE G-14 VEGETATION CHARACTERISTICS TYPICAL OF SEMIDESERT LOAM (WYOMING BIG SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	45%
Forbs	10%
Shrubs	45%

Source: NRCS (2020a)

2.7 Semidesert Sandy Loam (Winterfat) Ecological Site Description

Semidesert Sandy Loam (Winterfat) ecological sites in the TWE Project within the Cedar City FO occur on lake terraces on slopes ranging from 0% to 10% (NRCS 2020a). Major soil series associated with Semidesert Sandy Loam (Winterfat) ecological sites include Biblesprings, Escalante, Garbo, Manselo, Medburn, and Sevy. The climate in Semidesert Sandy Loam (Winterfat) ecological sites is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges from 8 to 12 inches. Annual distribution of precipitation varies during the wet and dry season. On average, March, April, and May are the wettest months and June, July, and August are the driest months.

2.7.1 Soil Characteristics

Semidesert Sandy Loam (Winterfat) ecological sites are characterized by moderately deep soils that are well drained with moderately slow to moderate permeability and low runoff potential (Table G-15; NRCS 2020a). Topsoil textures range from sandy loam to gravelly sandy clay loam and average depth is approximately 6.2 ± 2.5 inches. Subsoil textures are characterized by loam to sandy clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table G-15).

TABLE G-15 SOIL CHARACTERISTICS TYPICAL OF SEMIDESERT SANDY LOAM (WINTERFAT) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium derived from sedimentary (sandstone and shale) and igneous rocks
Topsoil depth	6.2 ± 2.5 inches
Topsoil texture	Sandy loam to gravelly sandy clay loam
Topsoil fragments	35% gravel
Topsoil pH	7.8–8.6
Topsoil salinity (EC)	0–8 dS/m
Topsoil sodicity (SAR)	0–10
Subsoil texture	Loam to sandy clay loam
Subsoil fragments	35% gravel
Subsoil pH	8.2–8.8
Subsoil salinity (EC)	0–8 dS/m
Subsoil sodicity (SAR)	0–10

Sources: NRCS (2020a, 2020d)

2.7.2 Vegetation

Vegetative composition by growth forms in Semidesert Sandy Loam (Winterfat) ecological sites is approximately 55% grasses, 10% forbs, and 35% shrubs (Table G-16; NRCS 2020a). The dominant grasses that may occur in Semidesert Sandy Loam (Winterfat) ecological sites include needle and thread, James' galleta, and Indian ricegrass (NRCS 2020a). Other grasses and grass-like plants that may occur include purple threeawn, blue grama, sandhill muhly, western wheatgrass, sand dropseed, and sixweeks fescue (*Festuca octoflora*). Winterfat is the major woody plant. Other woody plants that may occur include fourwing saltbush, yellow rabbitbrush, and Nevada jointfir (NRCS 2020a).

TABLE G-16 VEGETATION CHARACTERISTICS TYPICAL OF SEMIDESERT SANDY LOAM (WINTERFAT) ECOLOGICAL SITES

Growth Form	Composition
Grasses	55%
Forbs	10%
Shrubs	35%

Source: NRCS (2020a)

2.8 Semidesert Sandy Loam (Wyoming Big Sagebrush) Ecological Site Description

Semidesert Sandy Loam (Wyoming Big Sagebrush) ecological sites in the TWE Project within the Cedar City FO occur on alluvial fans, lake plains, and lake terraces on slopes ranging from 0% to 5% (NRCS 2020a). Major soil series associated with Semidesert Sandy Loam (Wyoming Big Sagebrush) ecological sites include Bandag, Berent, Biblesprings, Hiko Peak, Manselo, Medburn, and Sevy. The climate in Semidesert Sandy Loam (Wyoming Big Sagebrush) ecological sites is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges from 8 to 12 inches. Annual distribution of precipitation varies during the wet and dry season. On average, 70% of the precipitation falls as rain during March through October. On average, June through September are the driest months and March through May are the wettest months.

2.8.1 Soil Characteristics

Semidesert Sandy Loam (Wyoming Big Sagebrush) ecological sites are characterized by moderately deep soils that are well drained with moderately slow to moderate permeability and low runoff potential (Table G-17; NRCS 2020a). Topsoil textures range from loam fine sand to sandy loam and average depth is approximately 5.30 ± 2.17 inches. Subsoil textures are characterized by loam to fine sandy loam (NRCS 2020a). Subsoil texture is clayey. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table G-17).

TABLE G-17 SOIL CHARACTERISTICS TYPICAL OF SEMIDESERT SANDY LOAM (WYOMING BIG SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium derived from sedimentary (sandstone and shale) and igneous rocks
Topsoil depth	5.30 ± 2.17 inches
Topsoil texture	Loam fine sand to sandy loam
Topsoil fragments	10% gravel and 10% cobbles
Topsoil pH	8.0–8.6
Topsoil salinity (EC)	0–8 dS/m
Topsoil sodicity (SAR)	0–10
Subsoil texture	Loam to fine sandy loam
Subsoil fragments	35% gravel and 5% cobbles
Subsoil pH	8.2–9.0
Subsoil salinity (EC)	0–8 dS/m
Subsoil sodicity (SAR)	0–10

Sources: NRCS (2020a, 2020d)

2.8.2 Vegetation

Vegetative composition by growth forms in Semidesert Sandy Loam (Wyoming Big Sagebrush) ecological sites is approximately 55% grasses, 10% forbs, and 35% shrubs (Table G-18; NRCS 2020a). The dominant grasses that may occur in Semidesert Sandy Loam (Wyoming Big Sagebrush) ecological sites include needle and thread, wester wheatgrass, squirreltail, James' galleta, and Indian ricegrass (NRCS 2020a). Other grasses and grass-like plants that may occur include purple threeawn and sandhill muhly. Wyoming big sagebrush is the major woody plant. Other woody plants that may occur include fourwing saltbush, winterfat, and yellow rabbitbrush (NRCS 2020a).

TABLE G-18 VEGETATION CHARACTERISTICS TYPICAL OF SEMIDESERT SANDY LOAM (WYOMING BIG SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition
Grasses	55%
Forbs	10%
Shrubs	35%

Source: NRCS (2020a)

2.9 Semidesert Shallow Hardpan (Black Sagebrush) Ecological Site Description

Semidesert Shallow Hardpan (Black Sagebrush) ecological sites in the TWE Project within the Cedar City FO occur on alluvial fans and fan remnants on slopes ranging from 2% to 15% (NRCS 2020a). Major soil series associated with Semidesert Shallow Hardpan (Black Sagebrush) ecological sites include Crestline. The climate in Semidesert Shallow Hardpan (Black Sagebrush) ecological sites is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges from 9 to 13 inches. Annual distribution of precipitation varies during the wet and dry season. On average, March through May are the wettest months and June through September are the driest months during a water year (NRCS 2020a).

2.9.1 Soil Characteristics

Semidesert Shallow Hardpan (Black Sagebrush) ecological sites are characterized by a root-limiting petrocalcic layer and soils are well drained with moderately slow to moderate permeability and low to medium runoff potential (Table G-19; NRCS 2020a). Topsoil has a sandy loam texture and depth is approximately 6.0 inches. Subsoil textures are characterized by sandy loam to gravelly sandy loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table G-19).

TABLE G-19 SOIL CHARACTERISTICS TYPICAL OF SHALLOW HARDPAN (BLACK SAGEBRUSH) ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Alluvium derived from sedimentary (sandstone and shale) rocks
Topsoil depth	6.0 inches
Topsoil texture	Sandy loam
Topsoil fragments	15%–35% gravel
Topsoil pH	7.4
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–13
Subsoil texture	Sandy loam to gravelly sandy loam
Subsoil fragments	15%–35% gravel
Subsoil pH	7.4–8.0
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0–13

Sources: NRCS (2020a, 2020d)

2.9.2 Vegetation

Vegetative cover by growth forms in Semidesert Shallow Hardpan (Black Sagebrush) ecological sites is approximately 15% to 50% grasses, 2% to 10% forbs, and 55% to 80% shrubs (Table G-20; NRCS 2020a). The dominant grass species that may occur in Semidesert Shallow Hardpan (Black Sagebrush) ecological sites include Indian ricegrass, bluebunch wheatgrass, squirreltail, and needle and thread (NRCS 2020a). Other grasses that may occur include sand dropseed, western wheatgrass, James' galleta, Sandberg bluegrass, blue grama, and purple threeawn. Black sagebrush is the major woody plant. Other woody plants that may occur include yellow rabbitbrush (NRCS 2020a).

TABLE G-20 VEGETATION CHARACTERISTICS TYPICAL OF SEMIDESERT SHALLOW HARDPAN (BLACK SAGEBRUSH) ECOLOGICAL SITES

Growth Form	Composition	Cover
Grasses	–	15%–50%
Forbs	–	2%–10%
Shrubs	–	55%–80%

Source: NRCS (2020a)

ATTACHMENT G-1

Cedar City Field Office Photographs



Figure G-1-1 Representative Alkali Flat (Black Greasewood) in the Cedar City FO. Site ID 1216SF10.



Figure G-1-2 Representative Desert Alkali Sandy Loam (Shadscale) in the Cedar City FO. Site ID 1216MC12.



Figure G-1-3 Representative Desert Flat (Shadscale) in the Cedar City FO. Site ID 1215MC16.



Figure G-1-4 Representative Desert Sandy Loam (Fourwing Saltbush) in the Cedar City FO. Site ID 1217MC04.



Figure G-1-5 Representative Desert Sandy Loam (Shadscale) in the Cedar City FO.
Site ID 1217MC05.



Figure G-1-6 Representative Loamy 8–10 P.Z. in the Cedar City FO. Site ID 1214MC02.



Figure G-1-7 Representative Semidesert Alkali Loam (Black Greasewood) in the Cedar City FO.
Site ID 1218SF06.



Figure G-1-8 Representative Semidesert Loam (Wyoming Big Sagebrush) in the Cedar City FO.
Site ID 0503AF04.



**Figure G-1-9 Representative Semidesert Sand (Fourwing Saltbush) in the Cedar City FO.
Site ID 1215MC08.**



**Figure G-1-10 Representative Semidesert Sandy Loam (Winterfat) in the Cedar City FO.
Site ID 1213SF09.**



Figure G-1-11 Representative Semidesert Sandy Loam (Wyoming Big Sagebrush) in the Cedar City FO. Site ID 1215MC13.

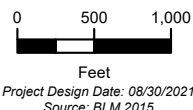
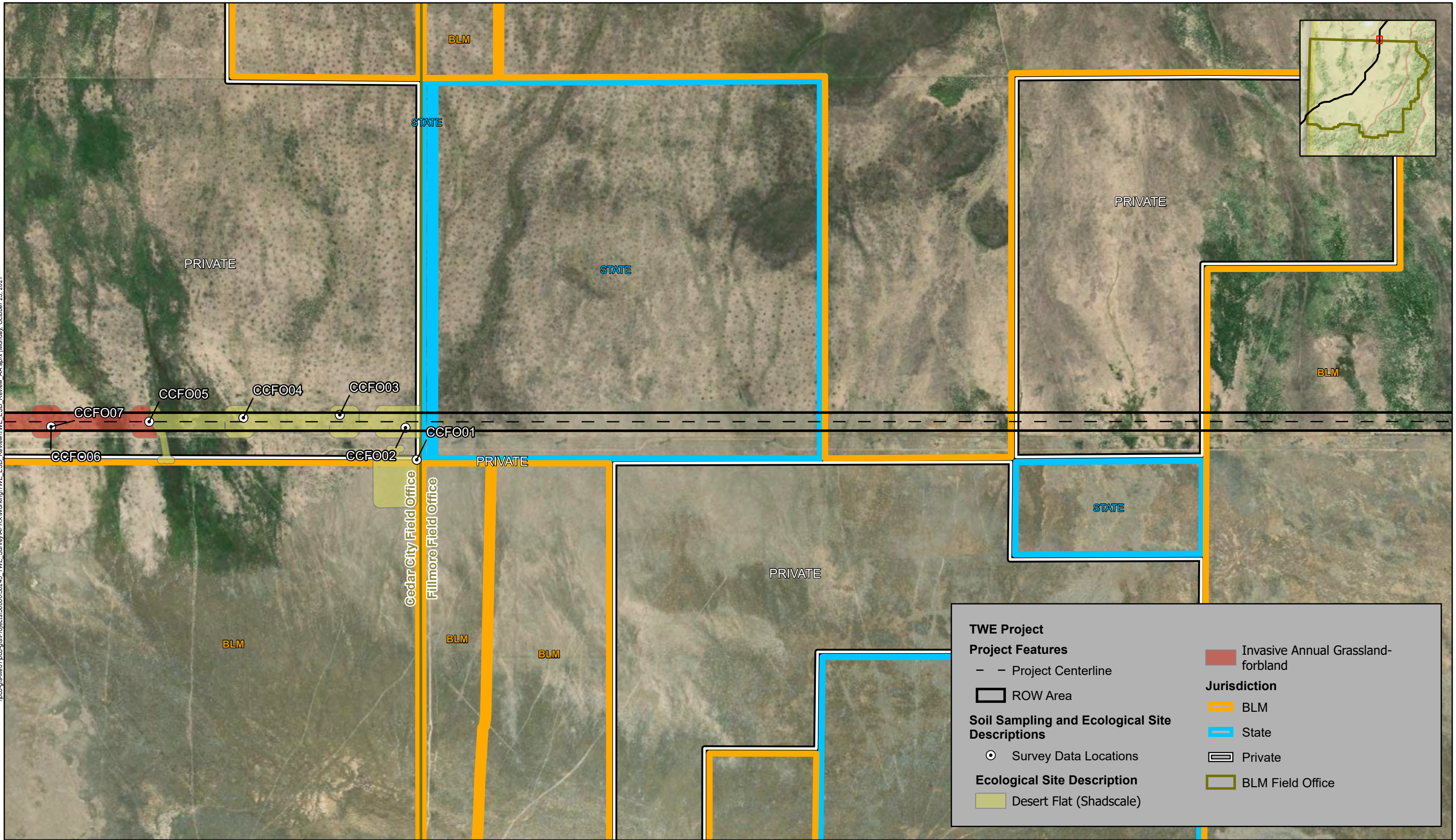


Figure G-1-12 Representative Semidesert Shallow Hardpan (Black Sagebrush) in the Cedar City FO. Site ID 1213SF17.

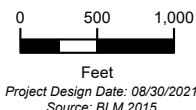
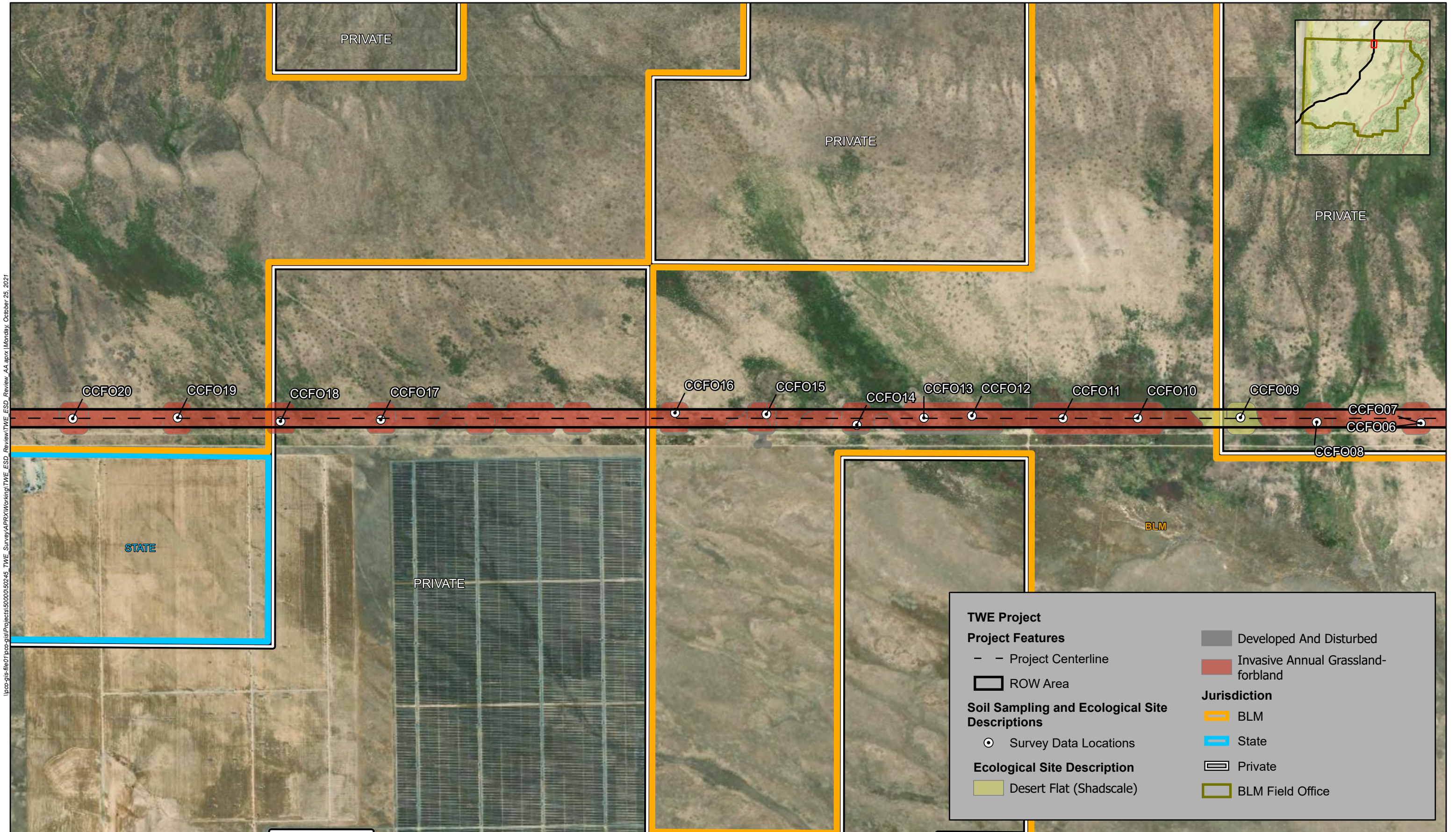
ATTACHMENT G-2

Cedar City Field Office Maps

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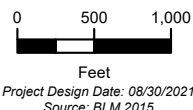
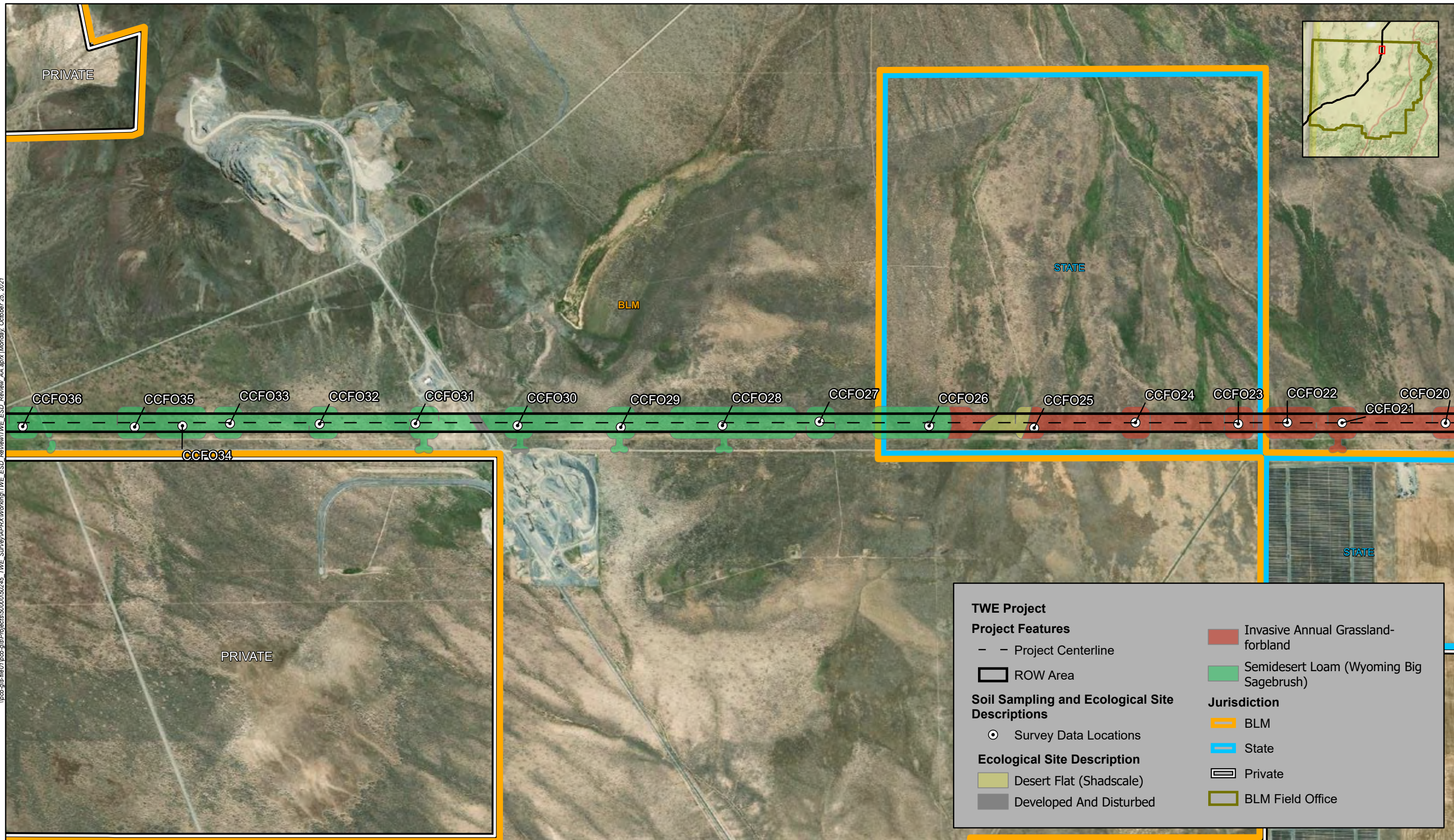


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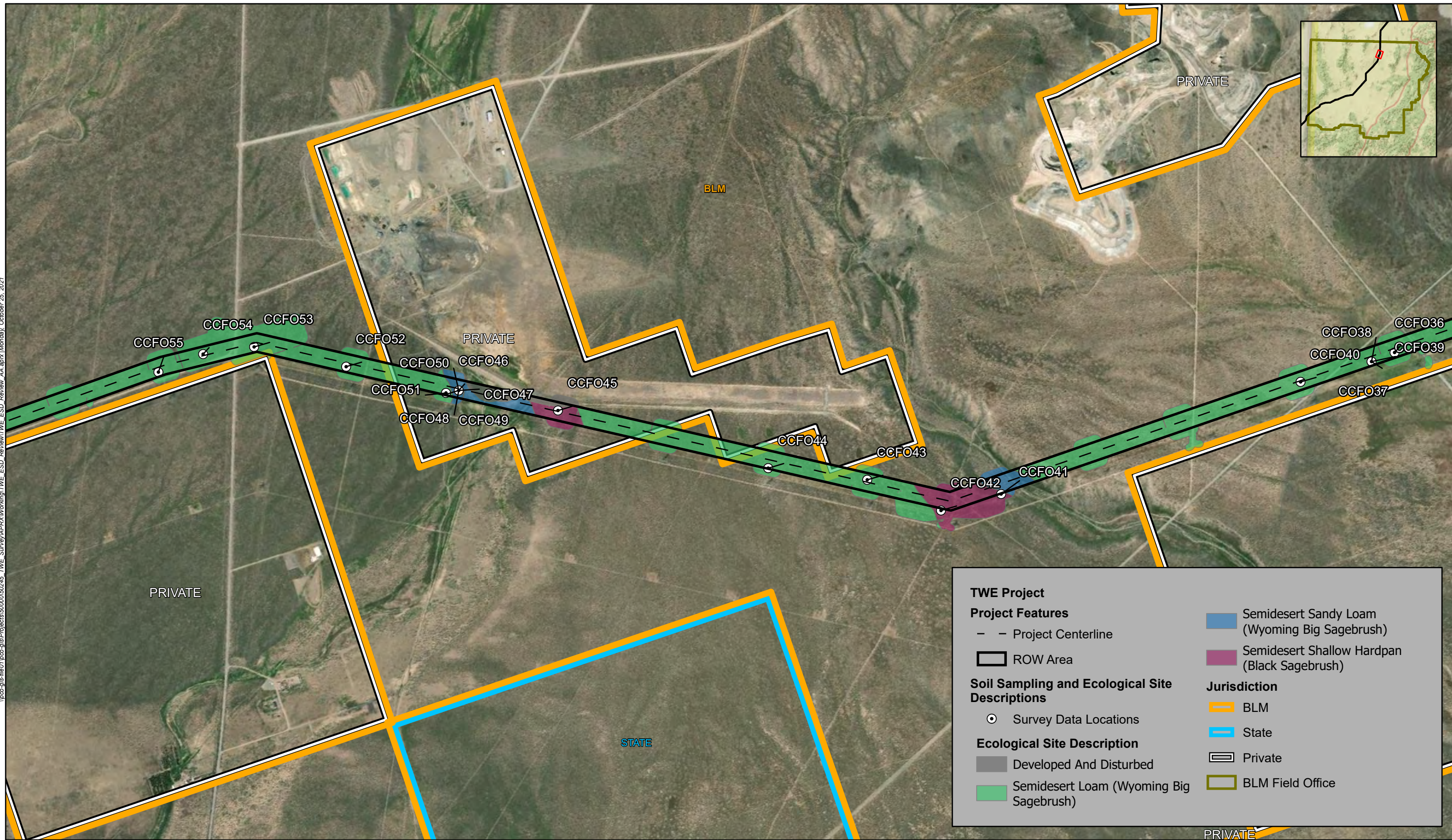
Ecological Site Descriptions - Cedar City Field Office
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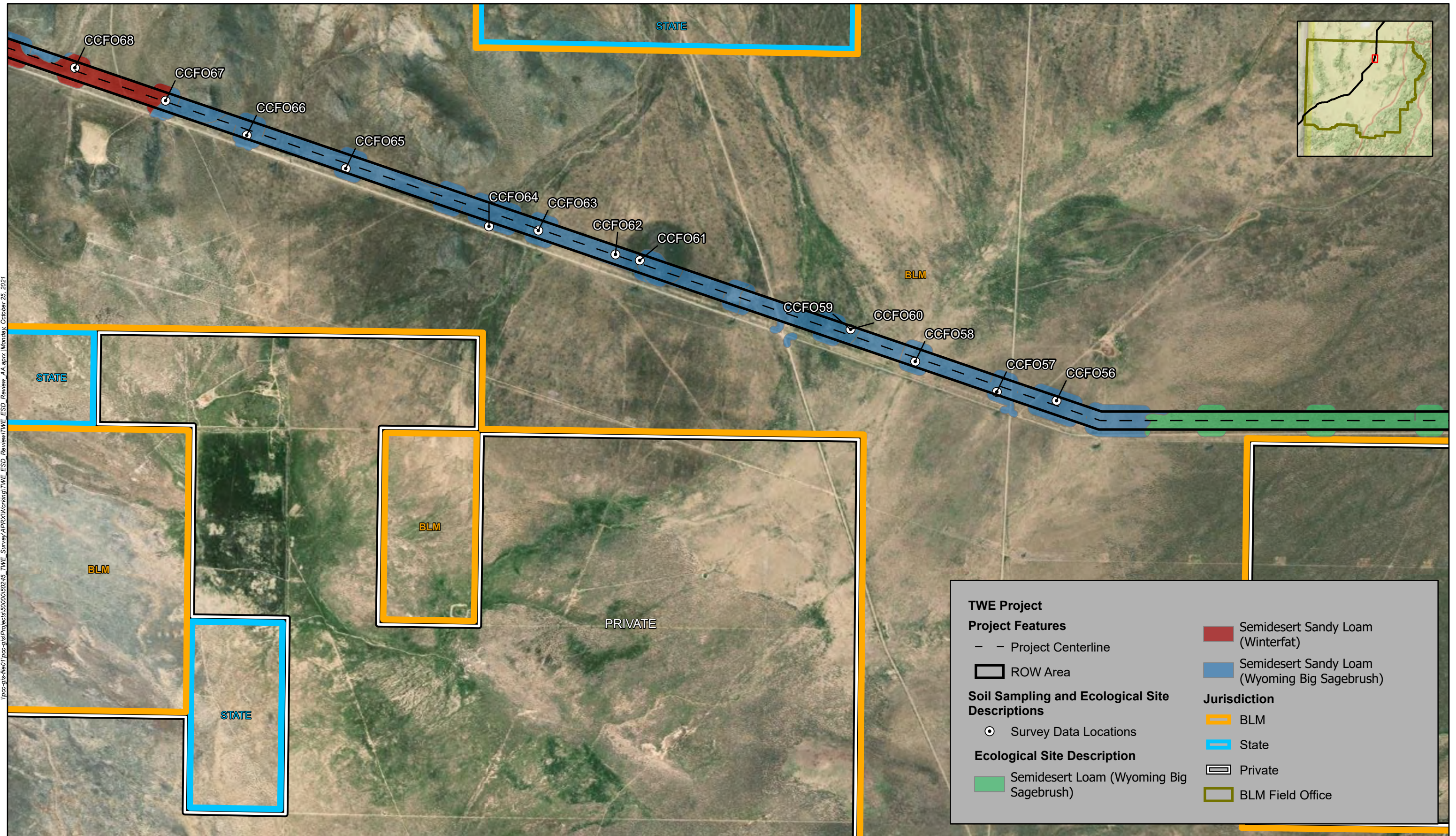
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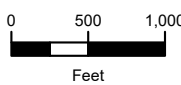

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Ecological Site Descriptions - Cedar City Field Office
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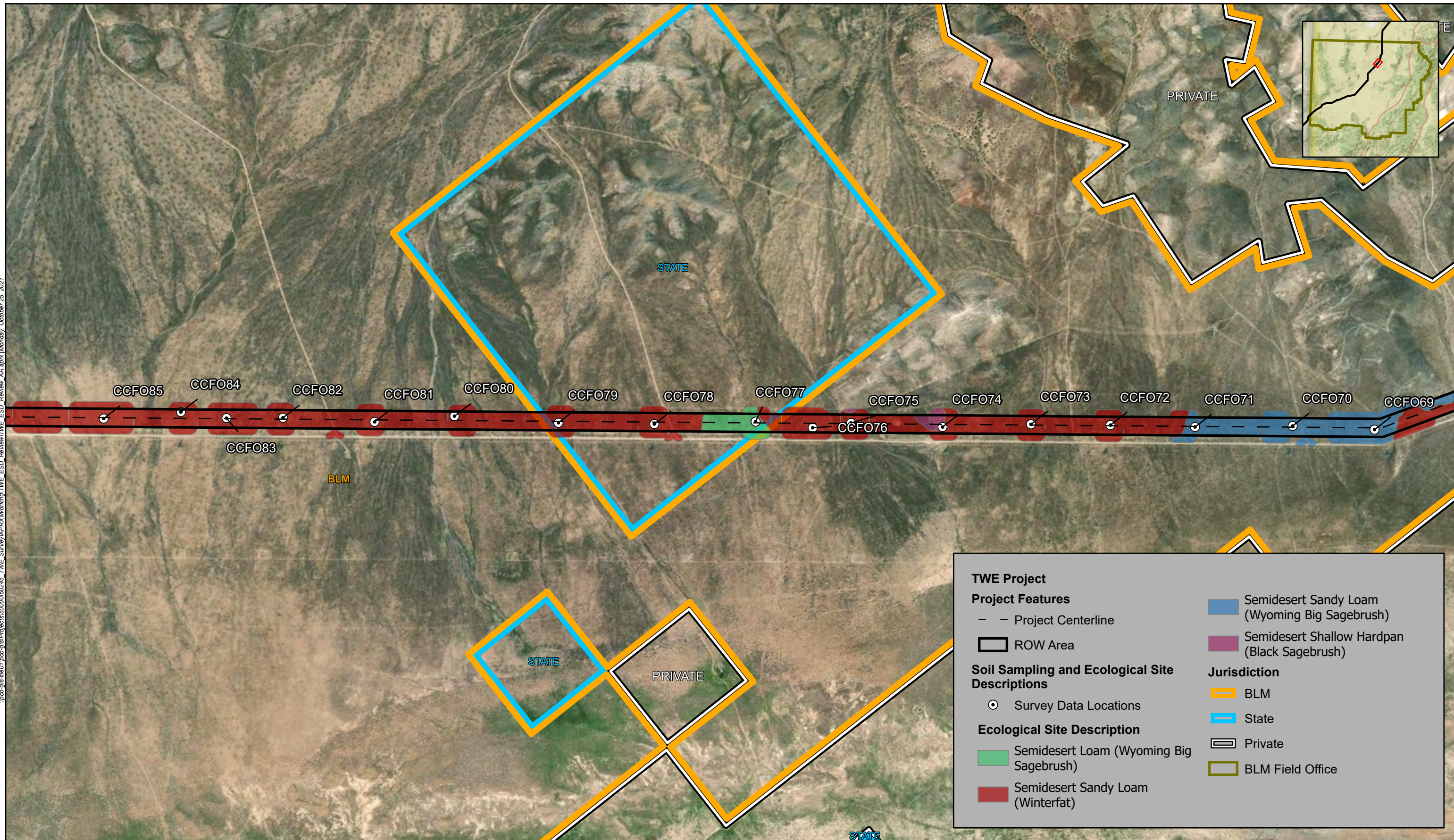
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TWE Project
Project Features

- - Project Centerline
- ▬ ROW Area

Soil Sampling and Ecological Site Descriptions

- Survey Data Locations

Ecological Site Description

- ▬ Semidesert Loam (Wyoming Big Sagebrush)
- ▬ Semidesert Sandy Loam (Winterfat)
- ▬ Semidesert Sandy Loam (Wyoming Big Sagebrush)
- ▬ Semidesert Shallow Hardpan (Black Sagebrush)

Jurisdiction

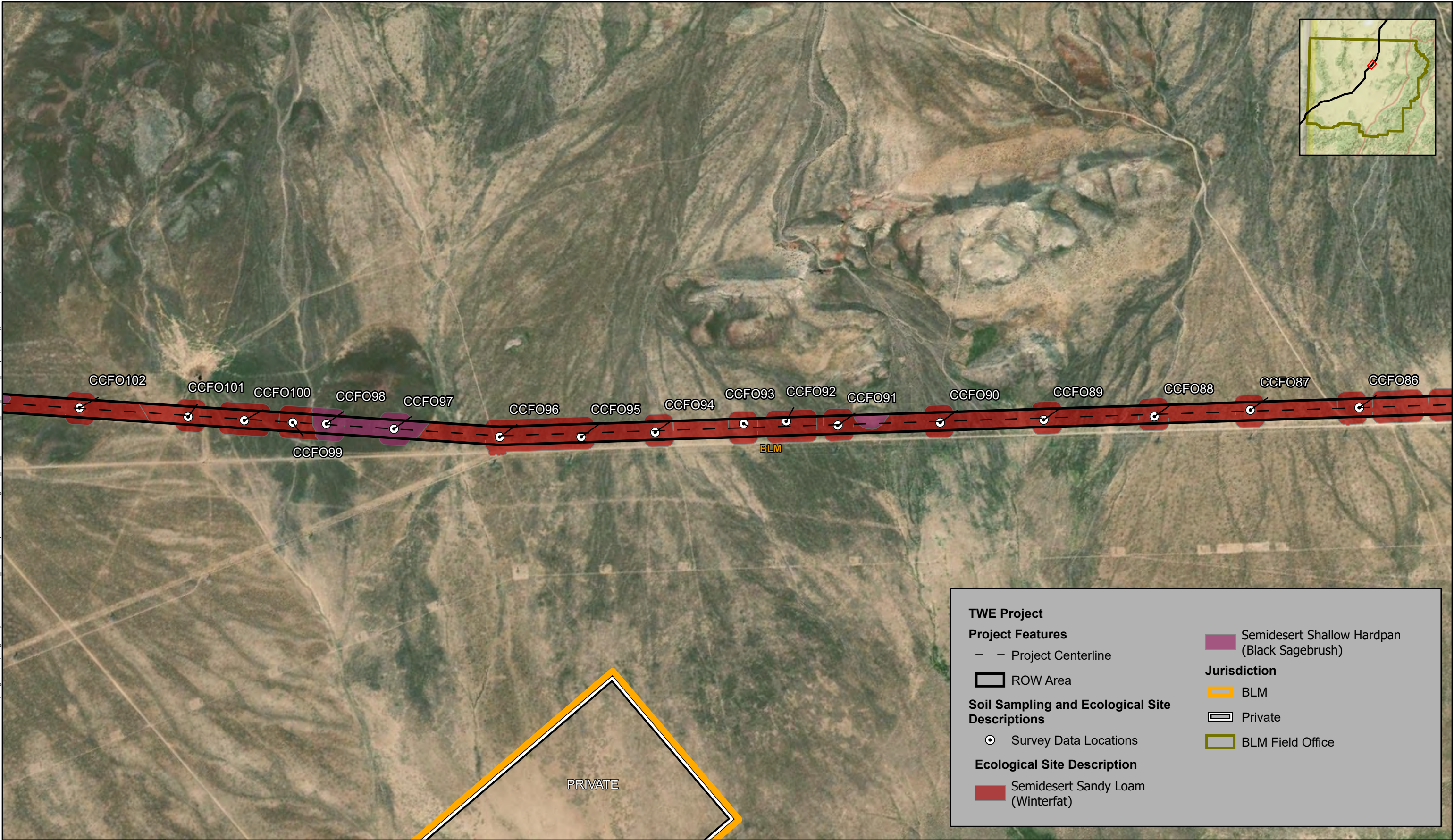
- ▬ BLM
- ▬ State
- ▬ Private
- ▬ BLM Field Office



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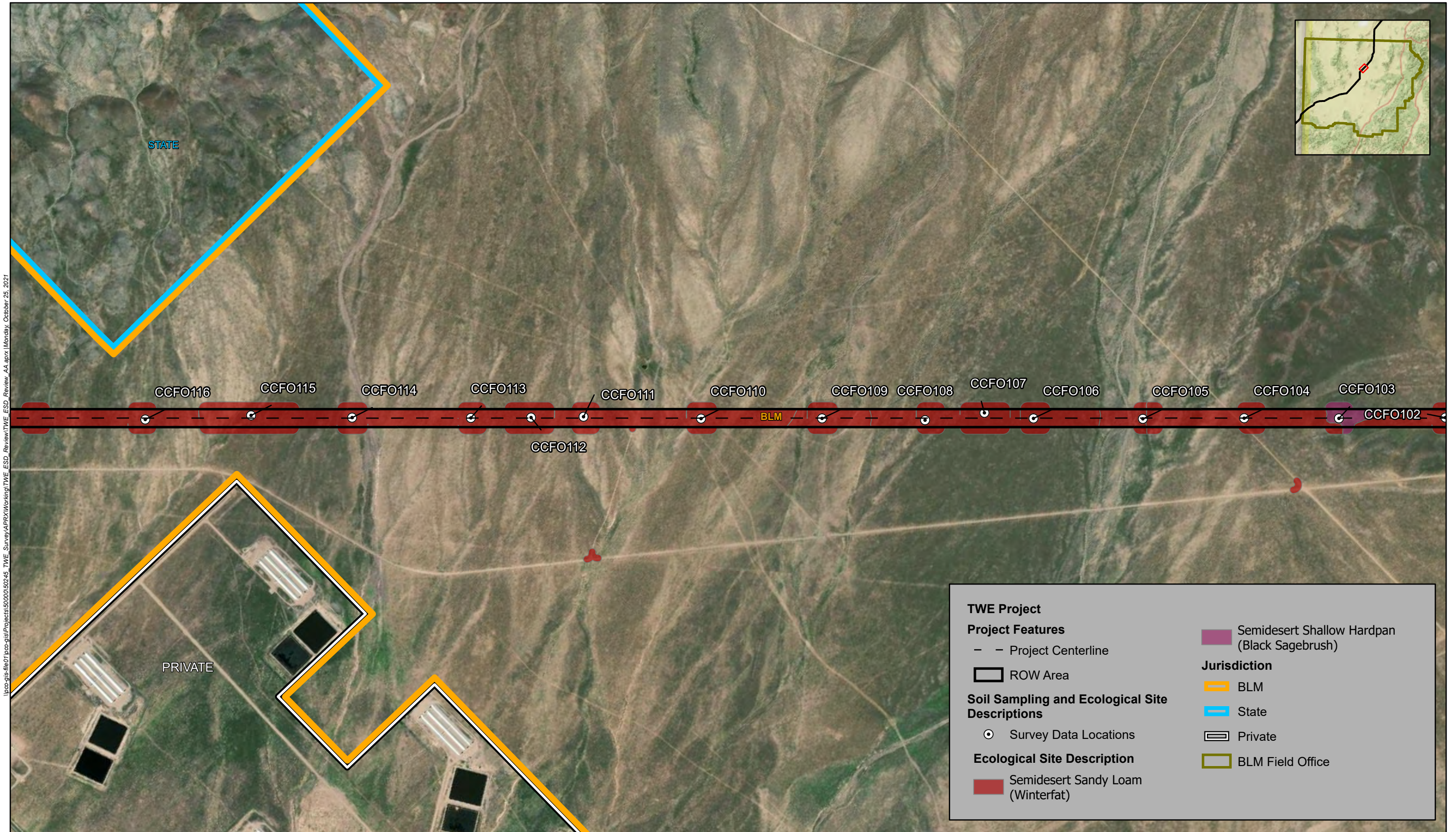
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TransWest Express Transmission Project



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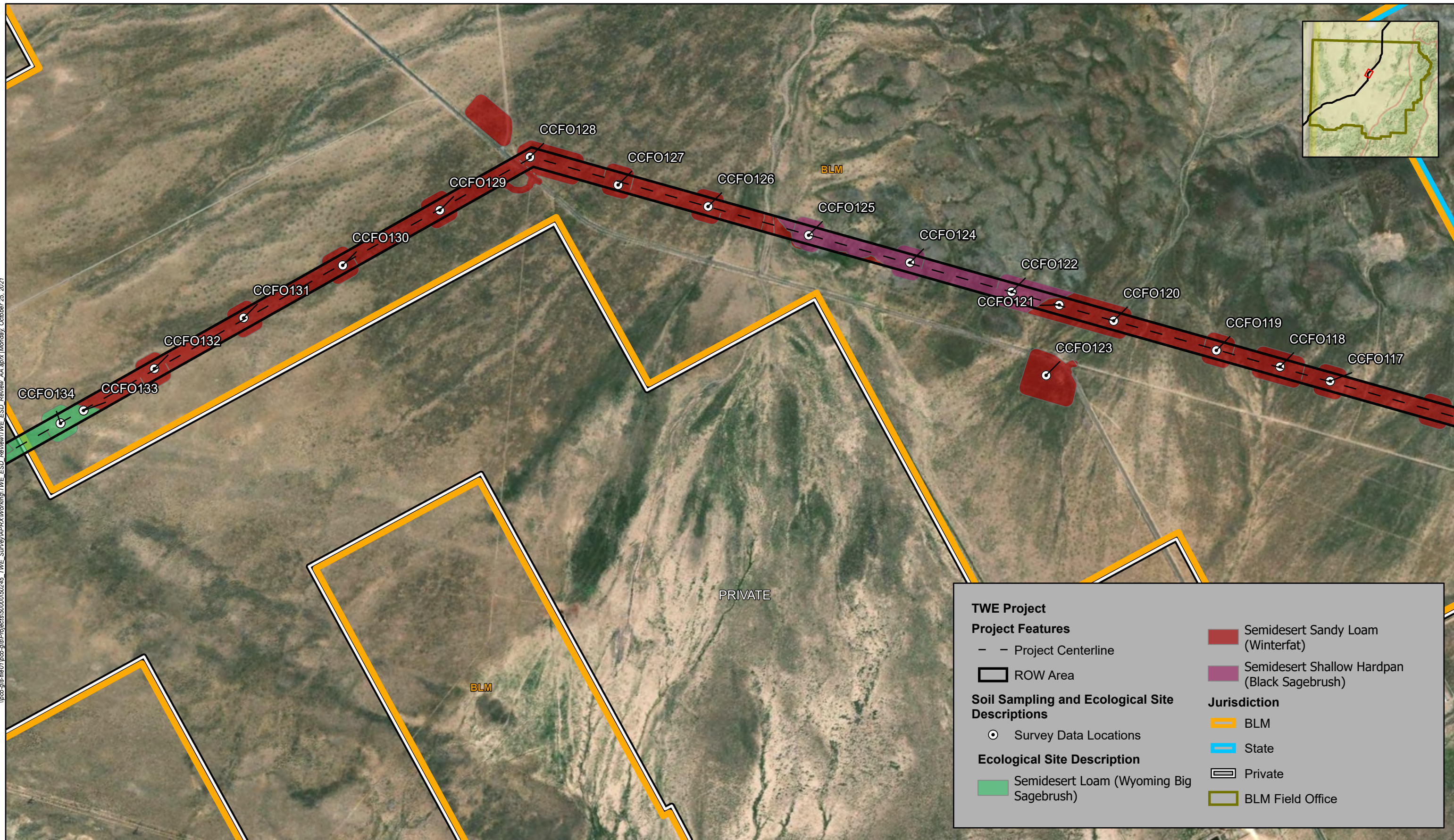
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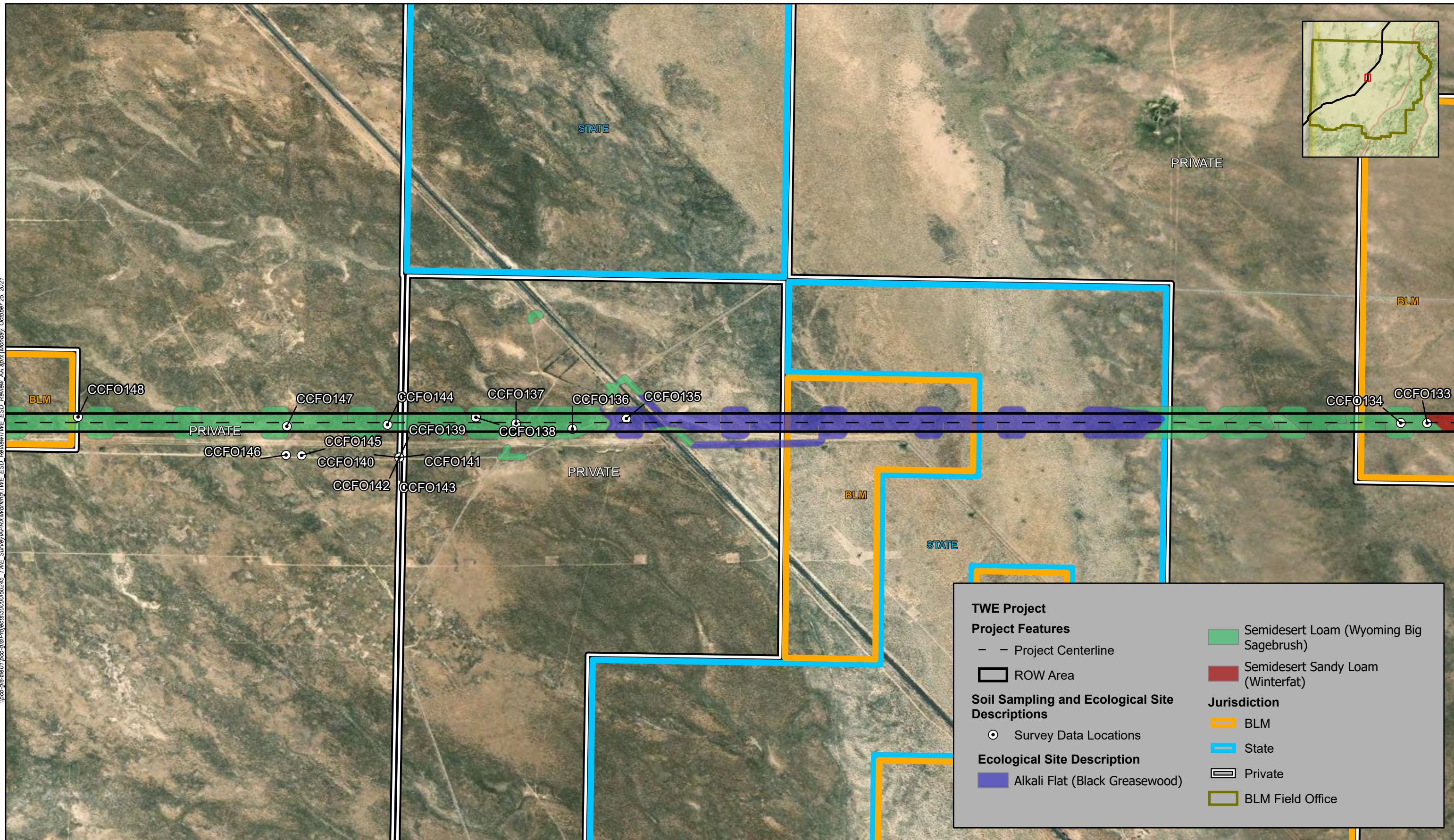
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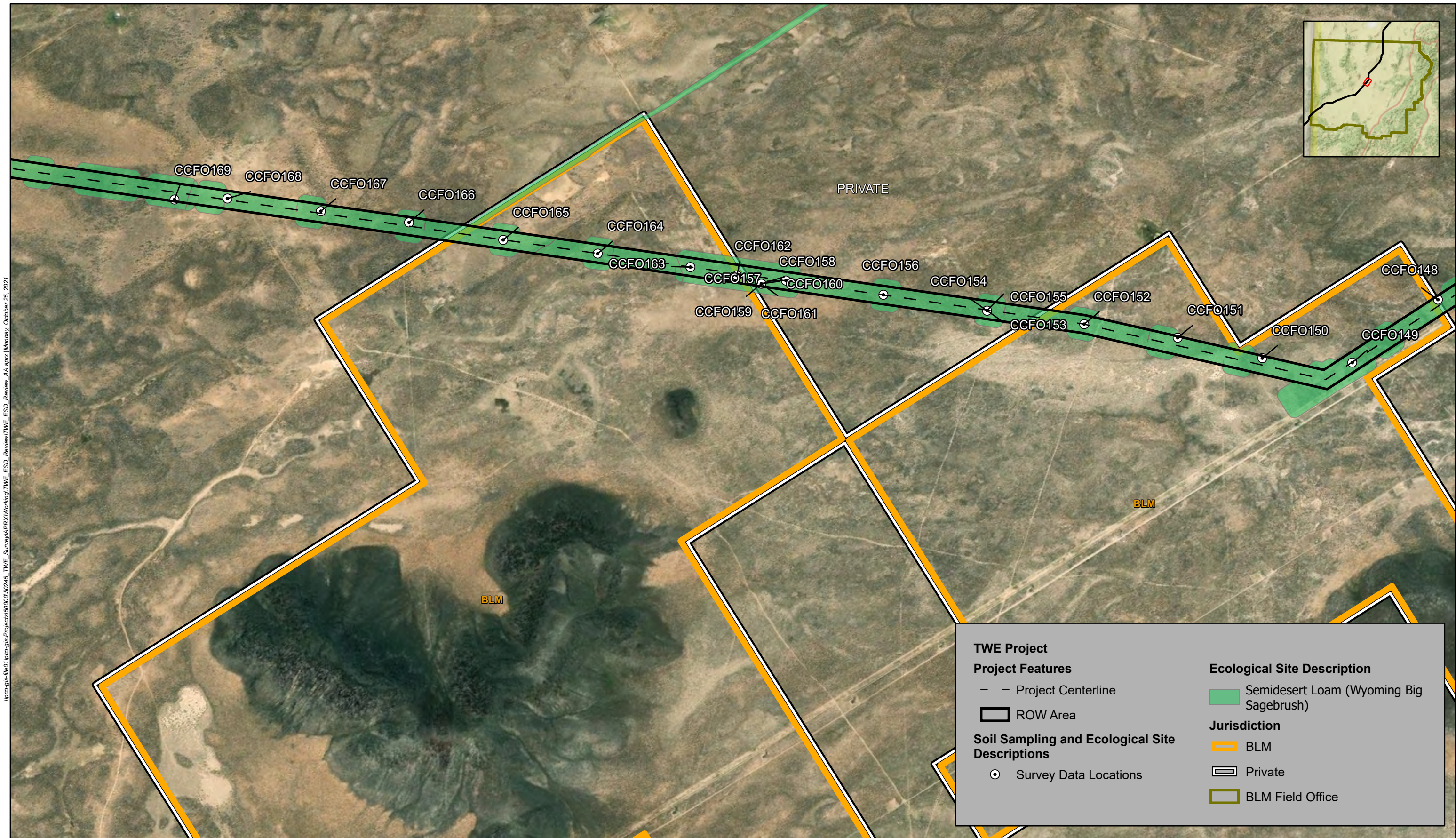
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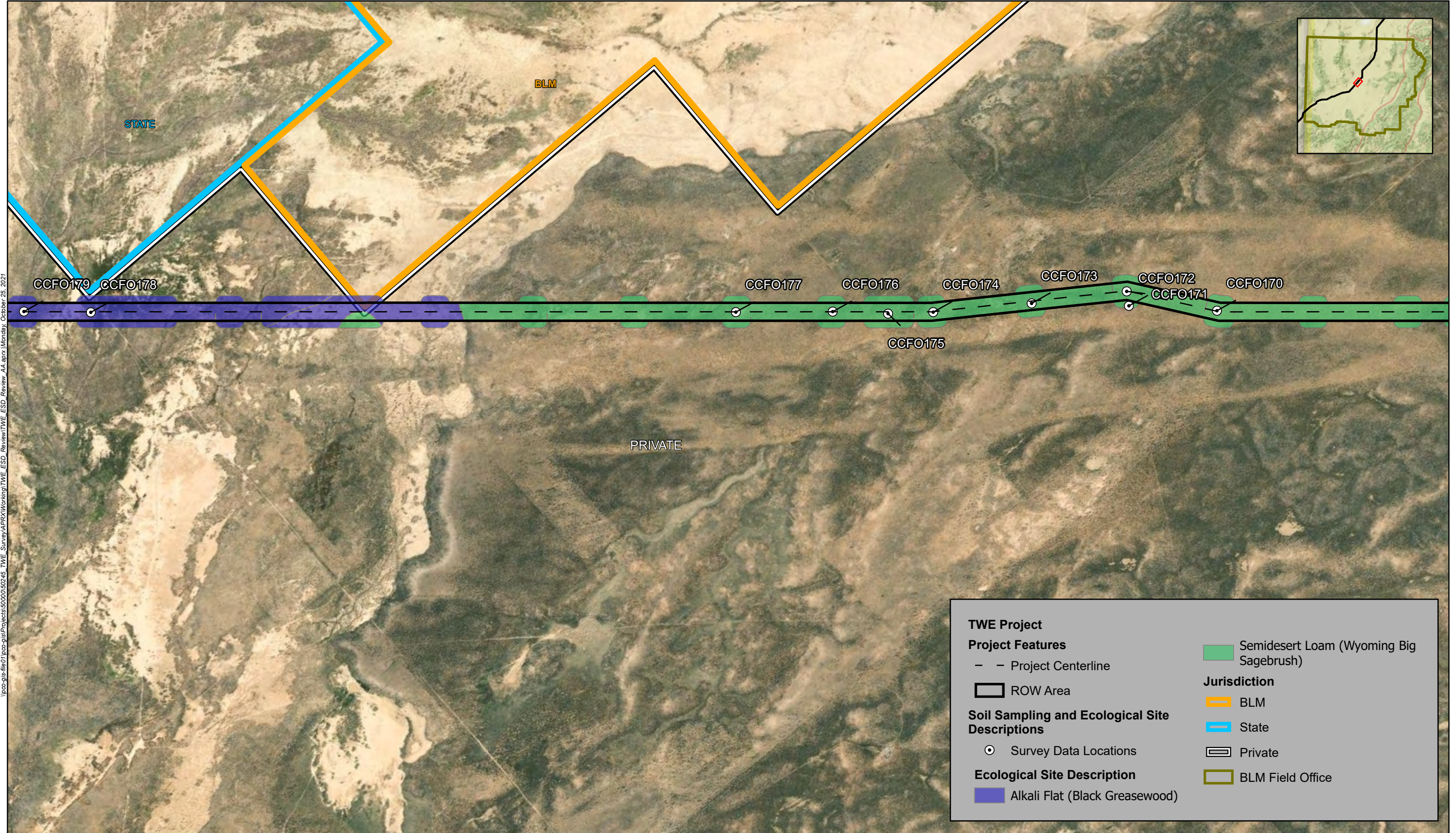
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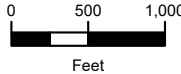

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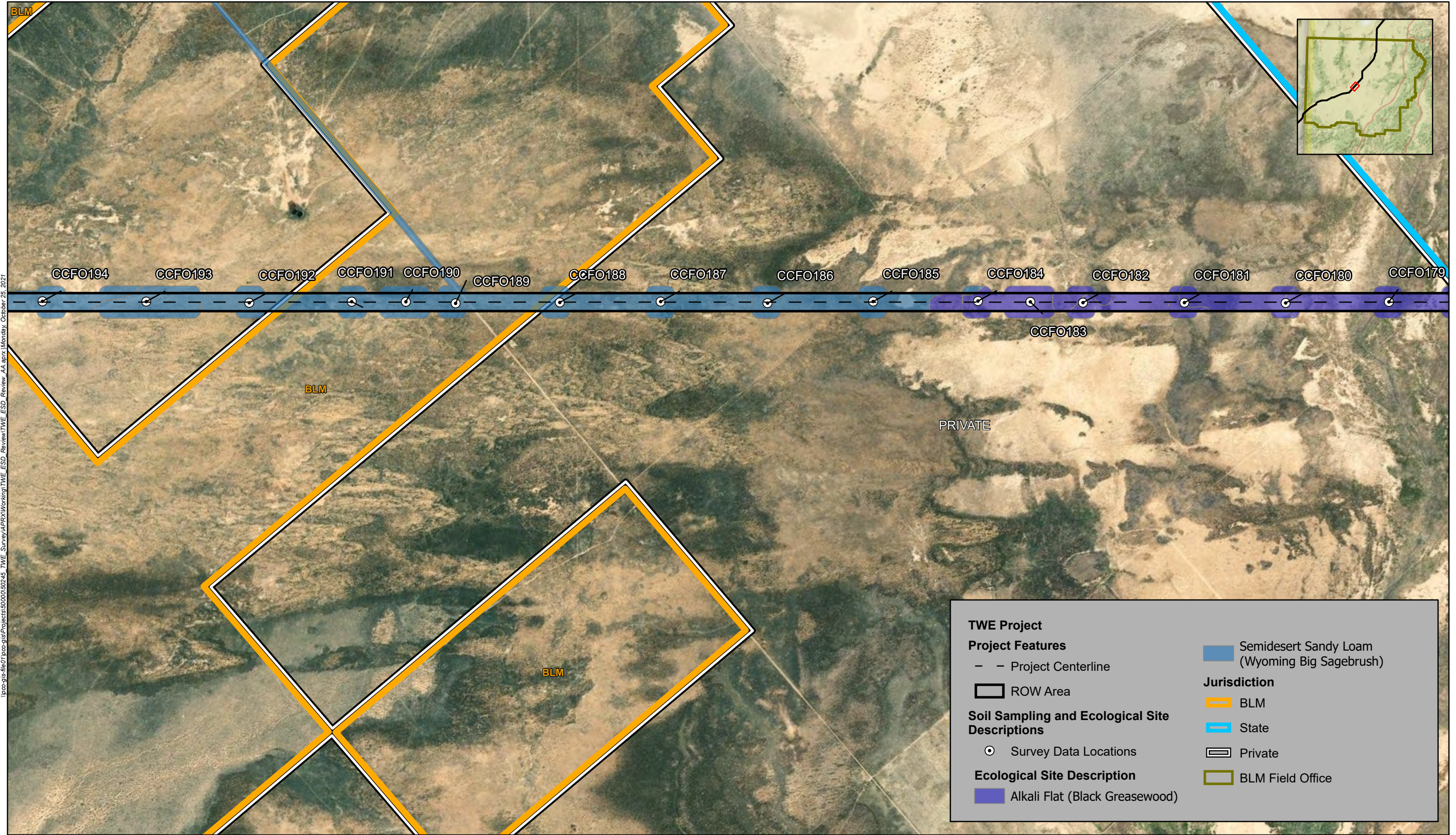


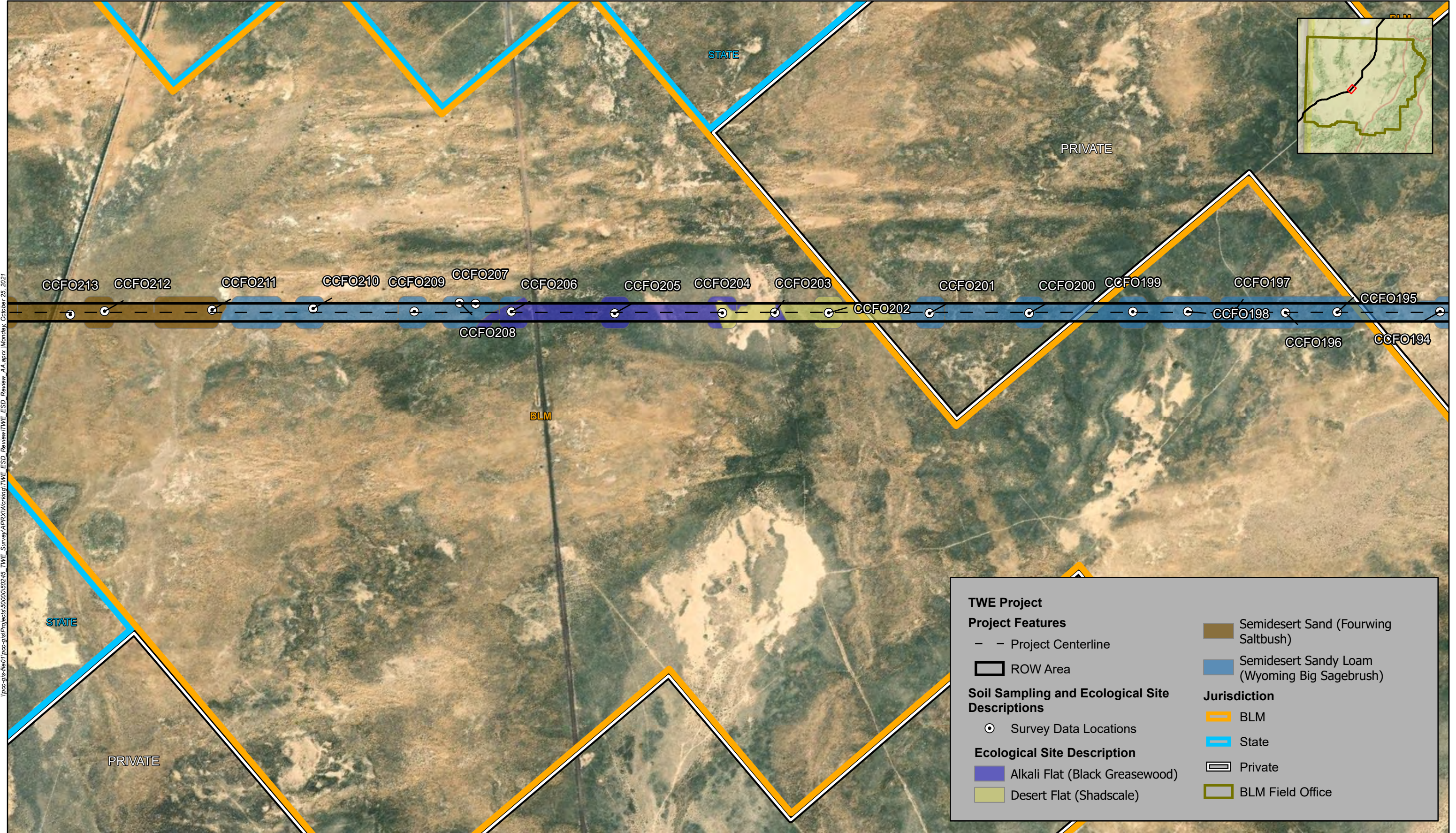


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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- Survey Data Locations

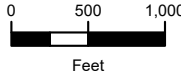

Ecological Site Description

- Alkali Flat (Black Greasewood)
- Desert Flat (Shadscale)

- Semidesert Sand (Fourwing Saltbush)
- Semidesert Sandy Loam (Wyoming Big Sagebrush)

Jurisdiction

- ▬ BLM
- ▬ State
- ▬ Private
- ▬ BLM Field Office

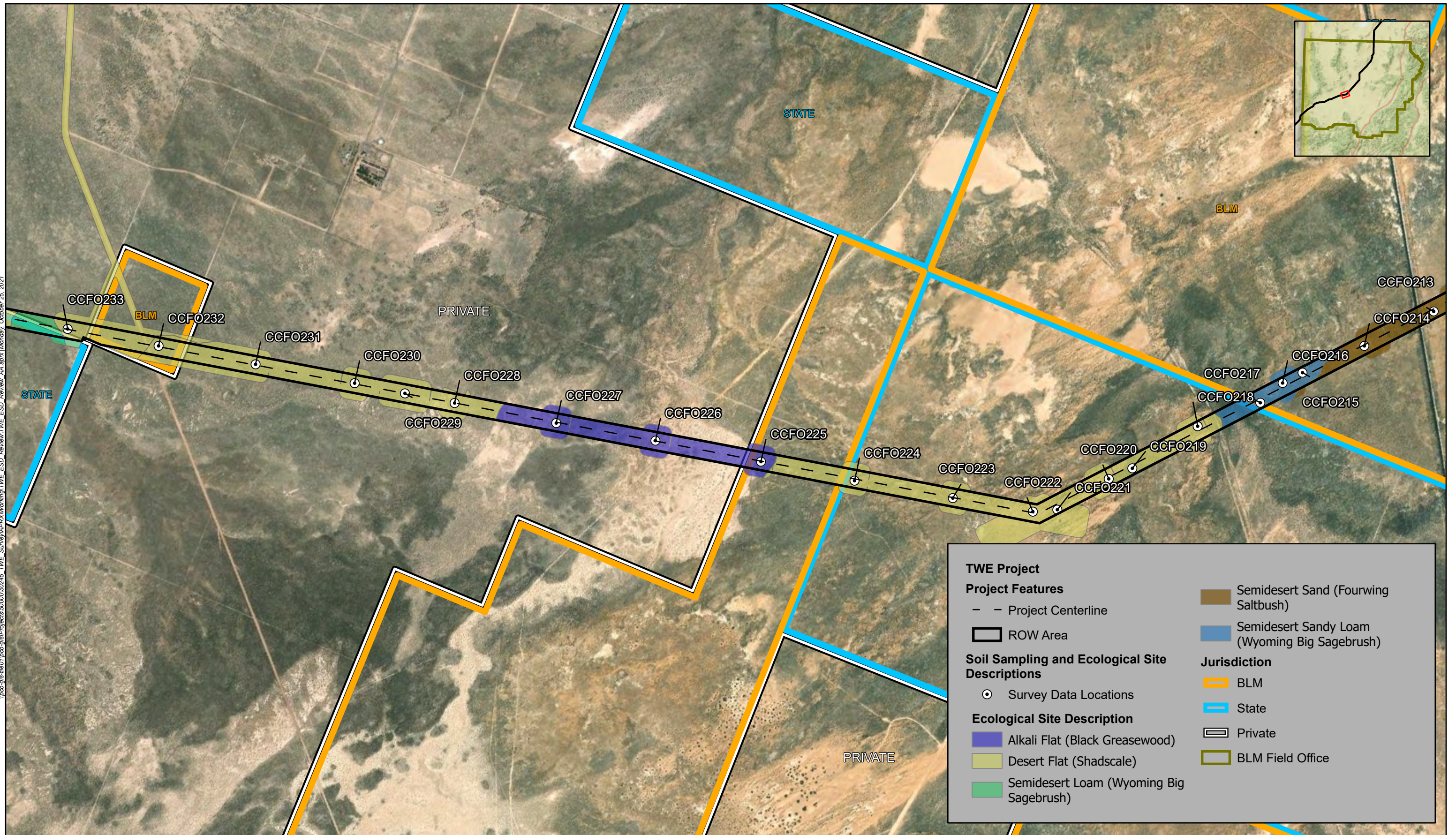


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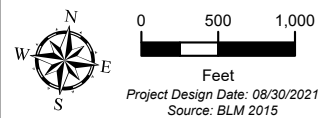
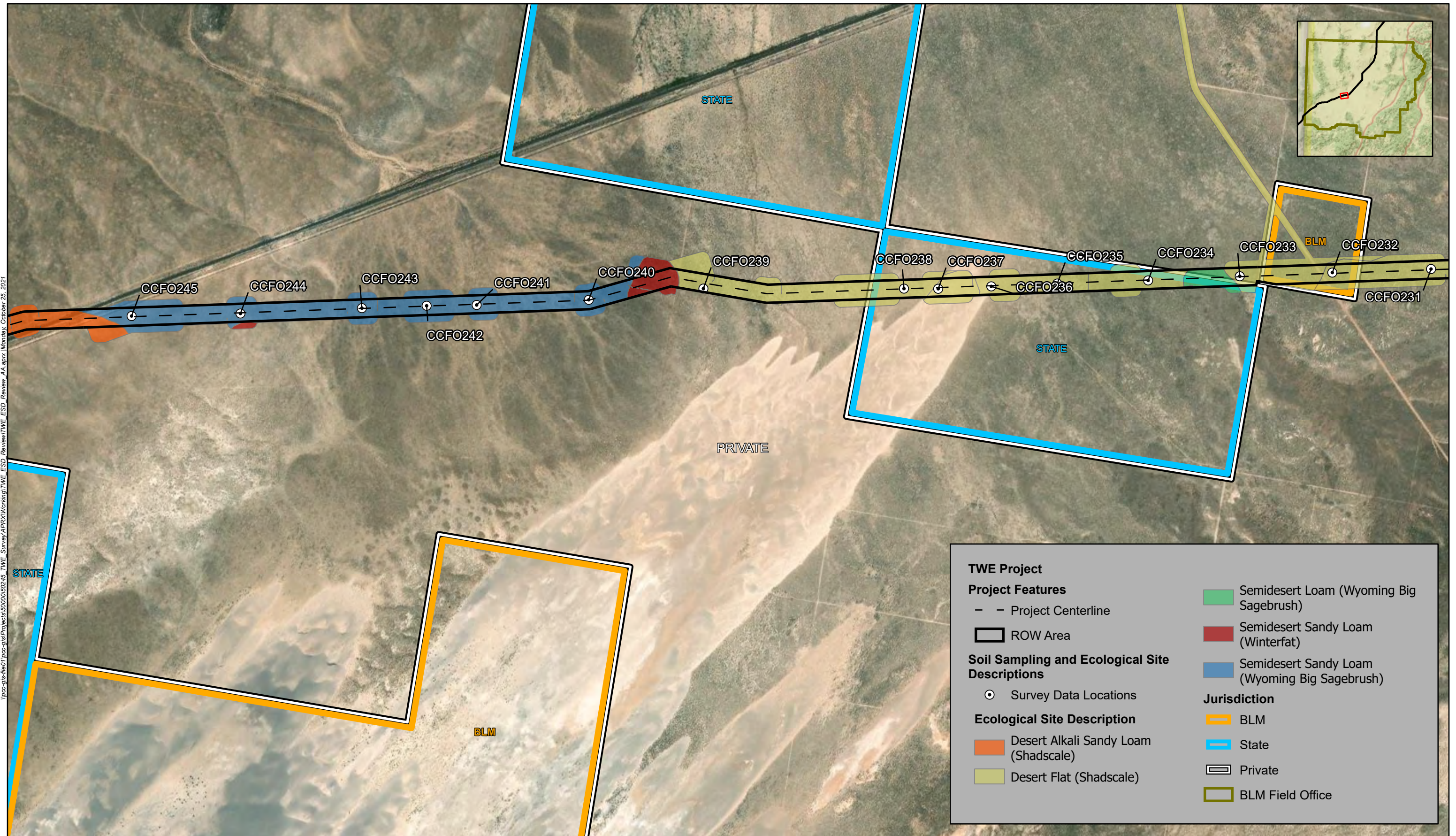
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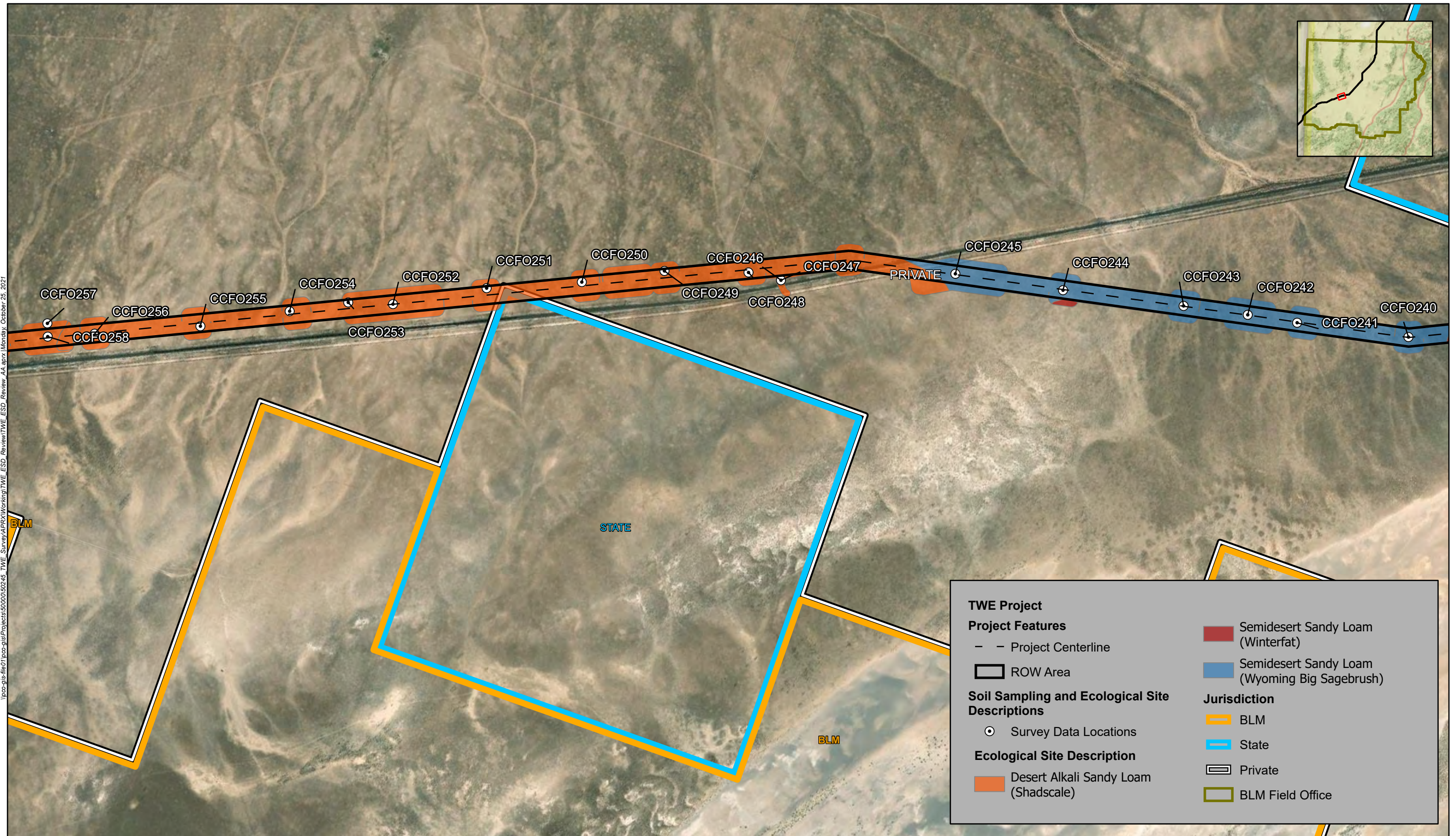
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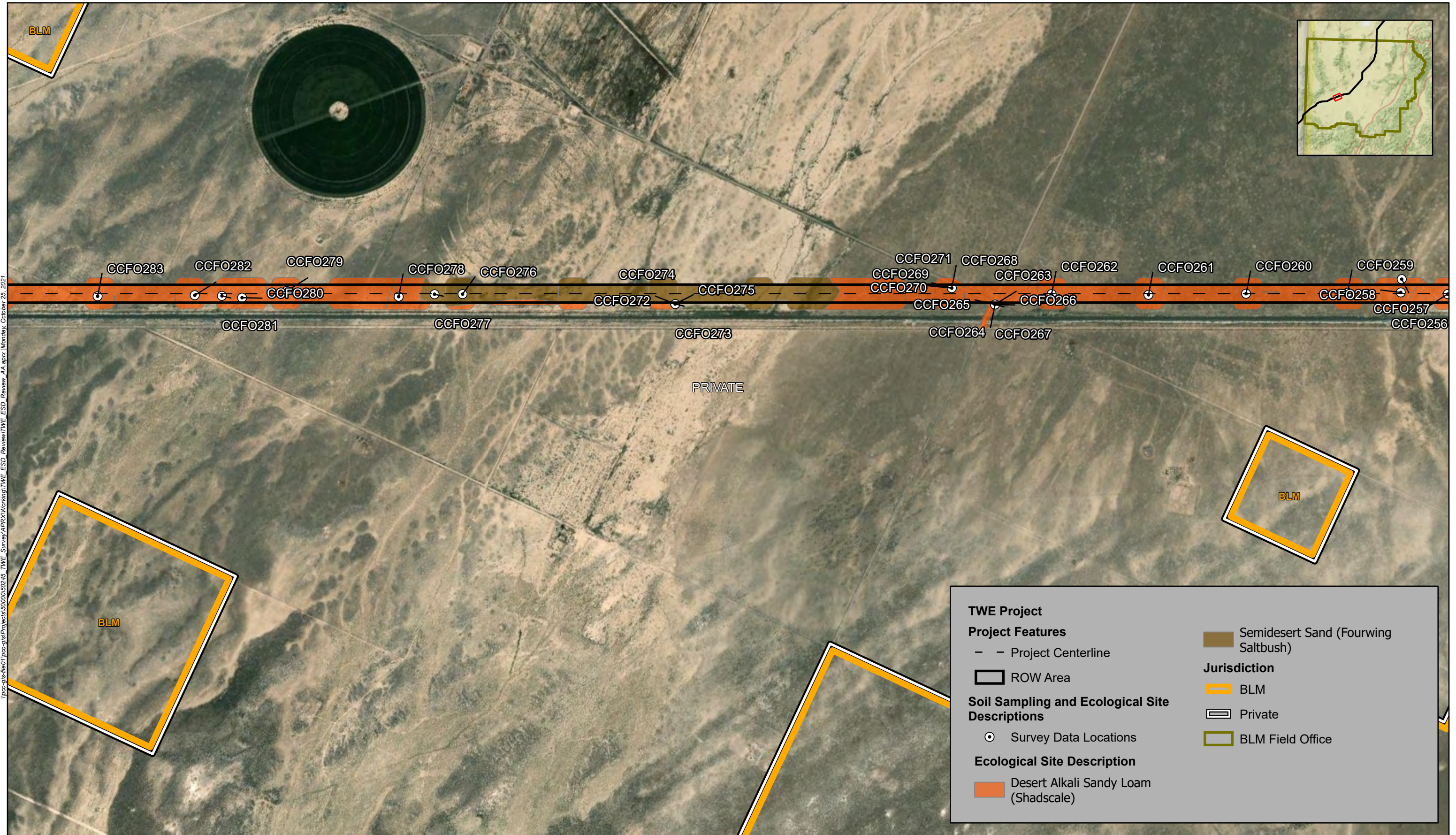


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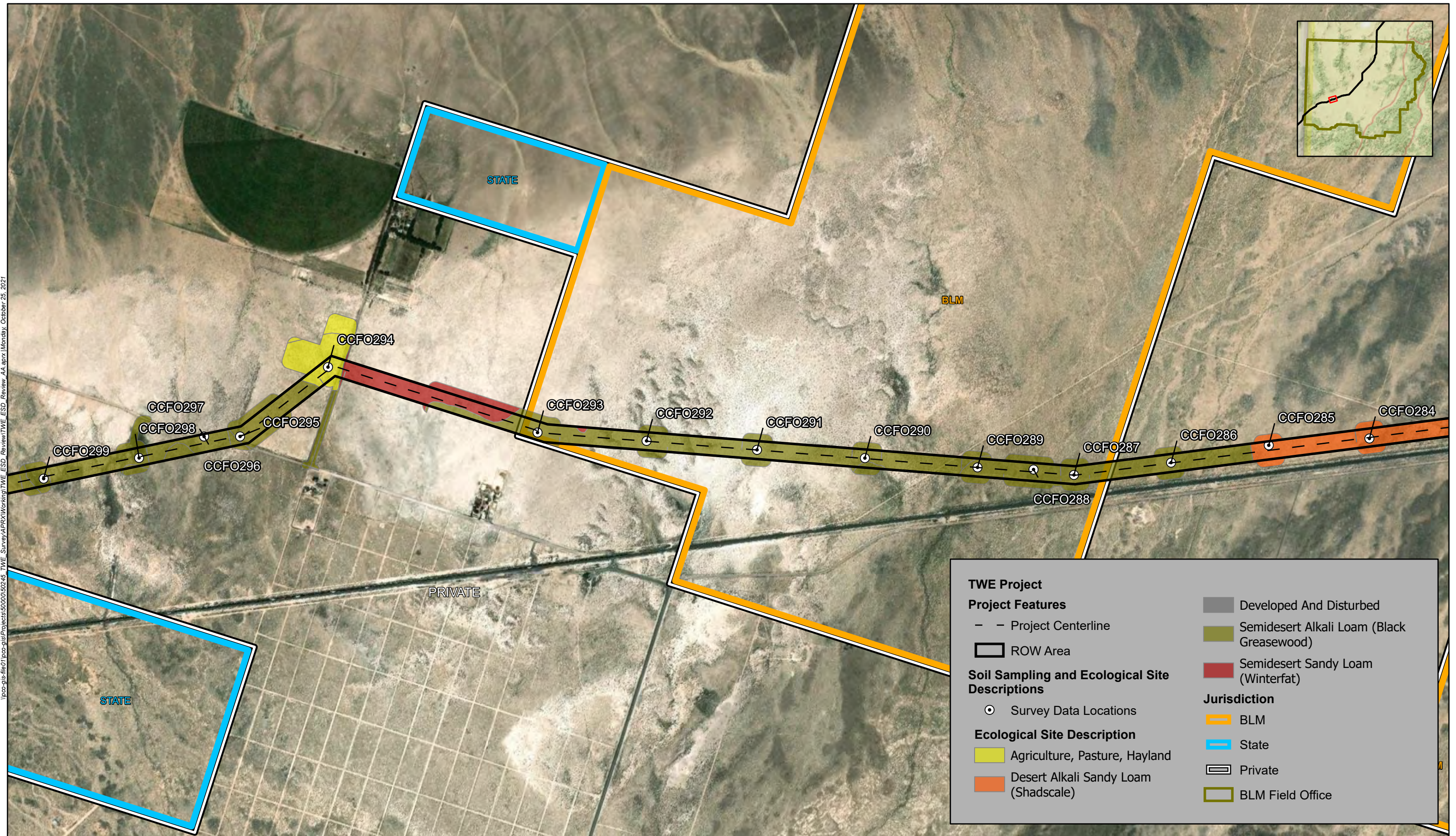
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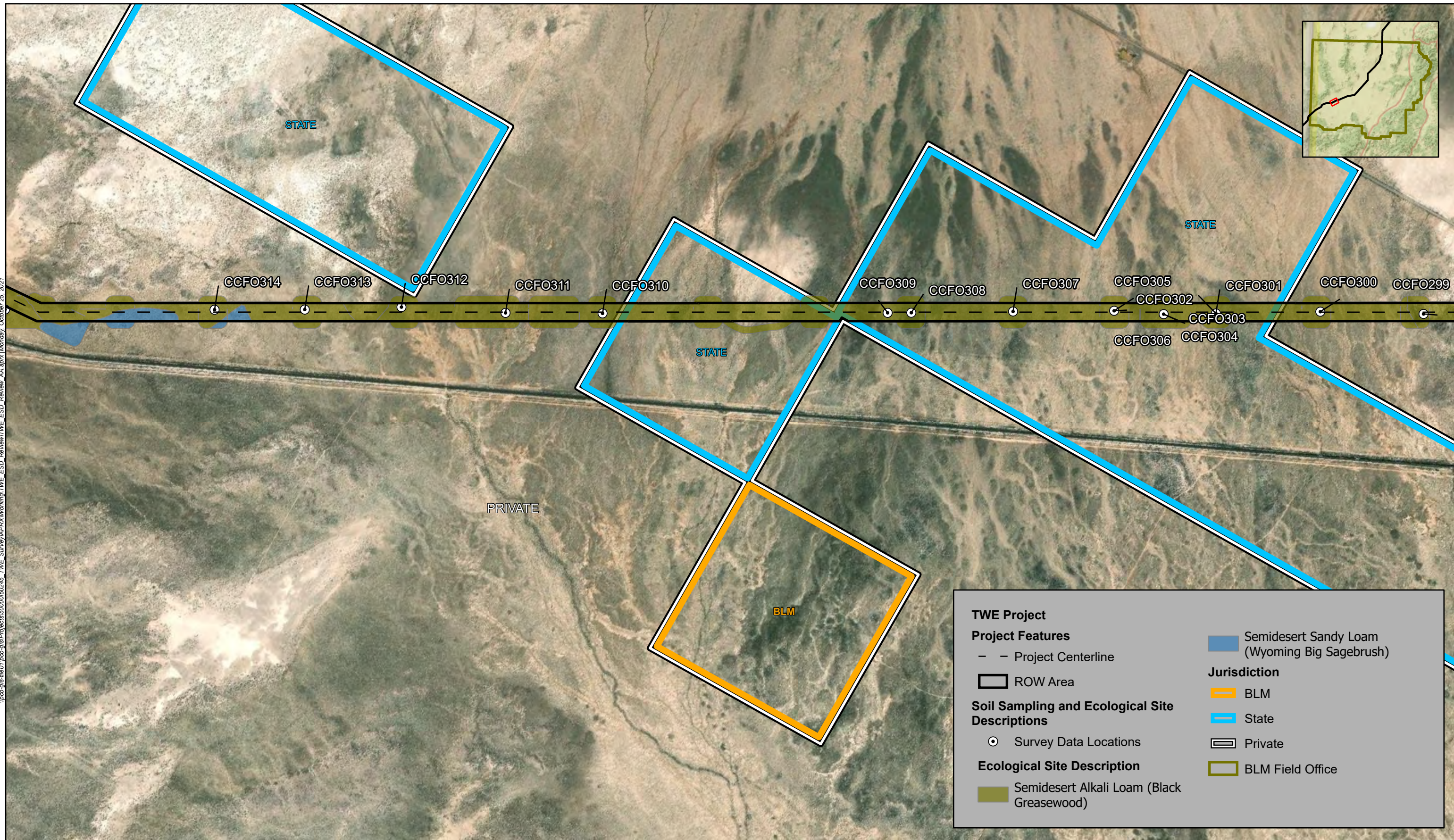
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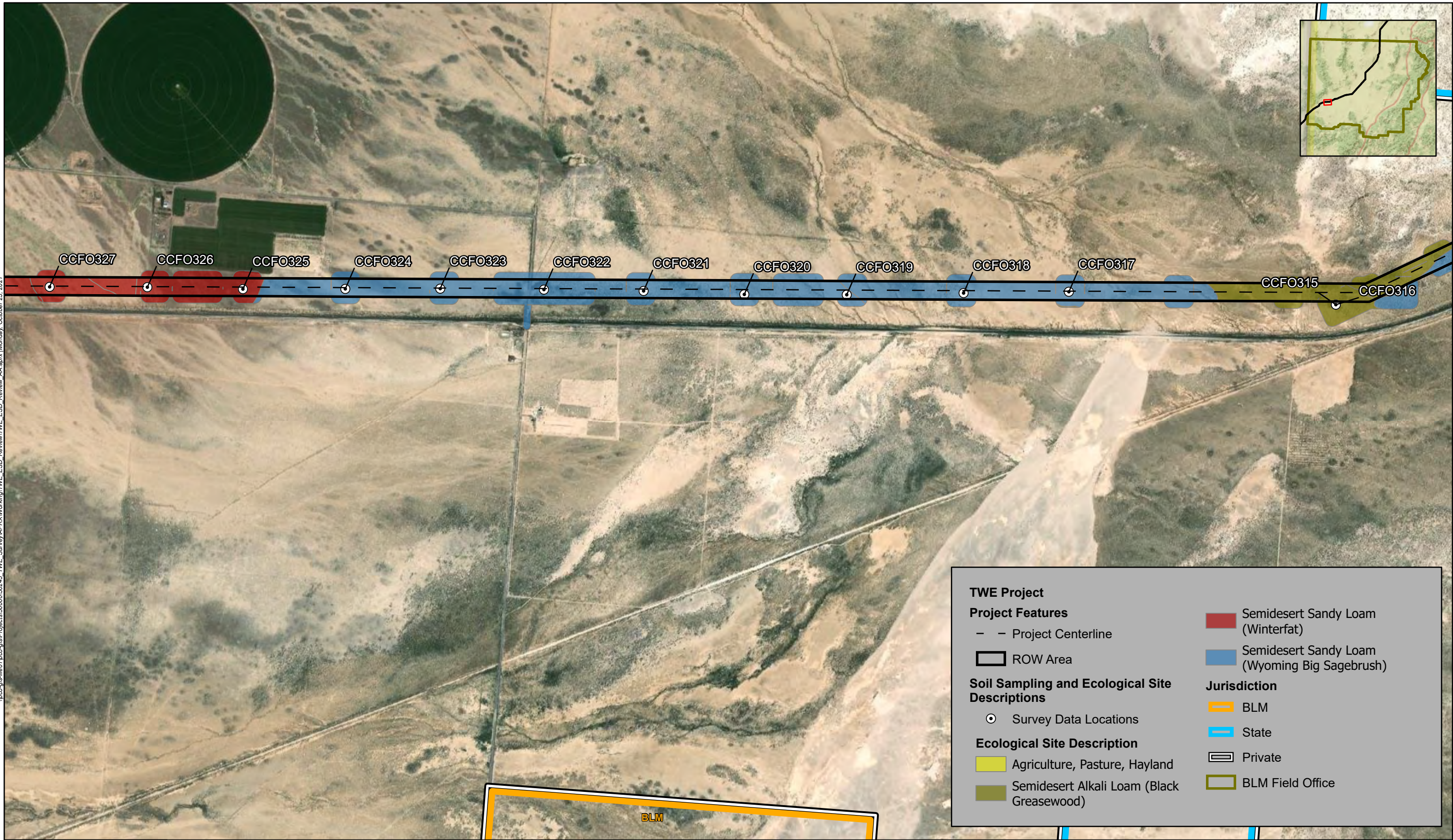
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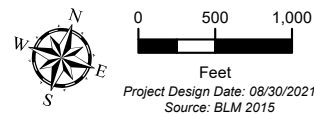
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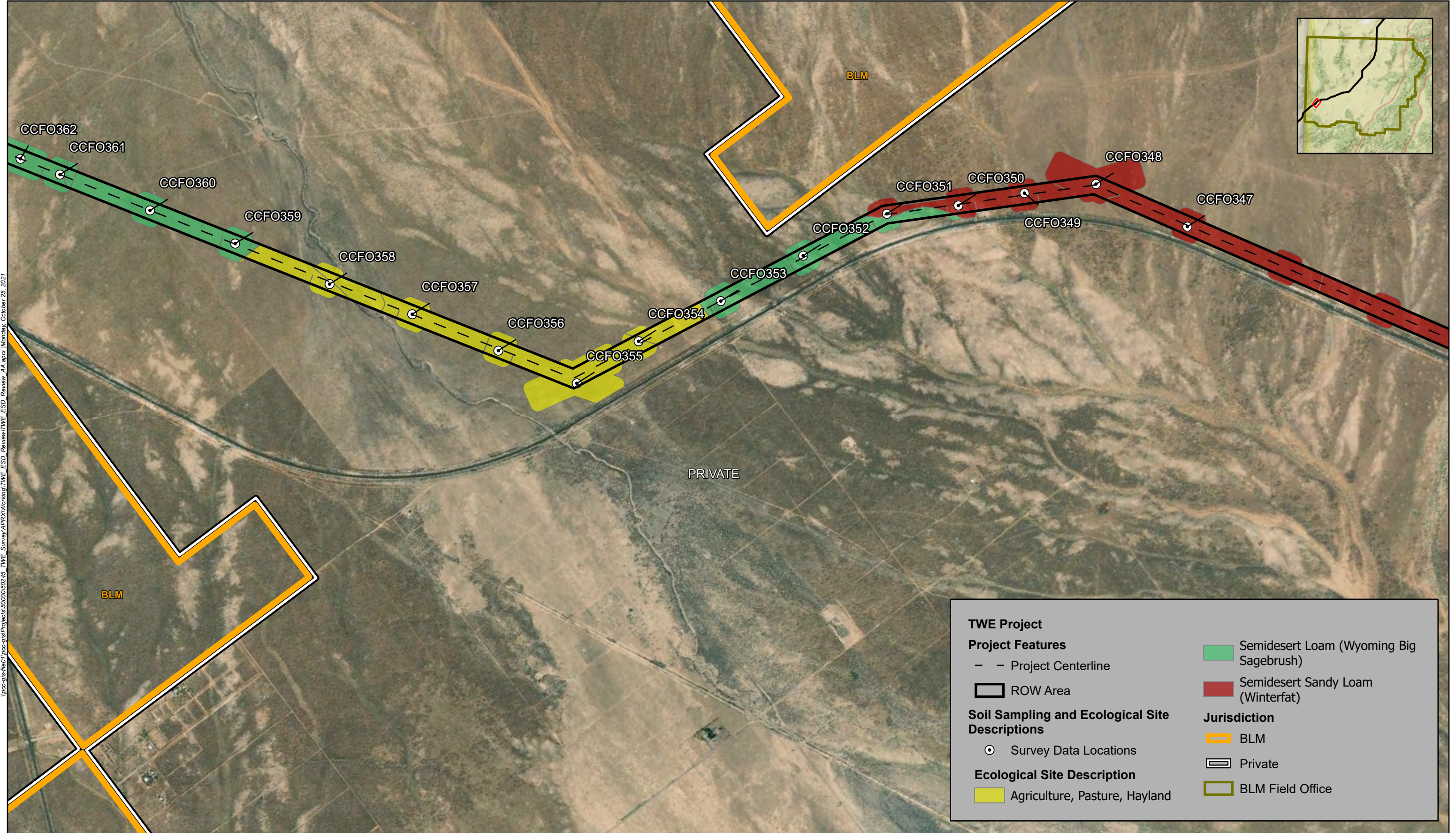
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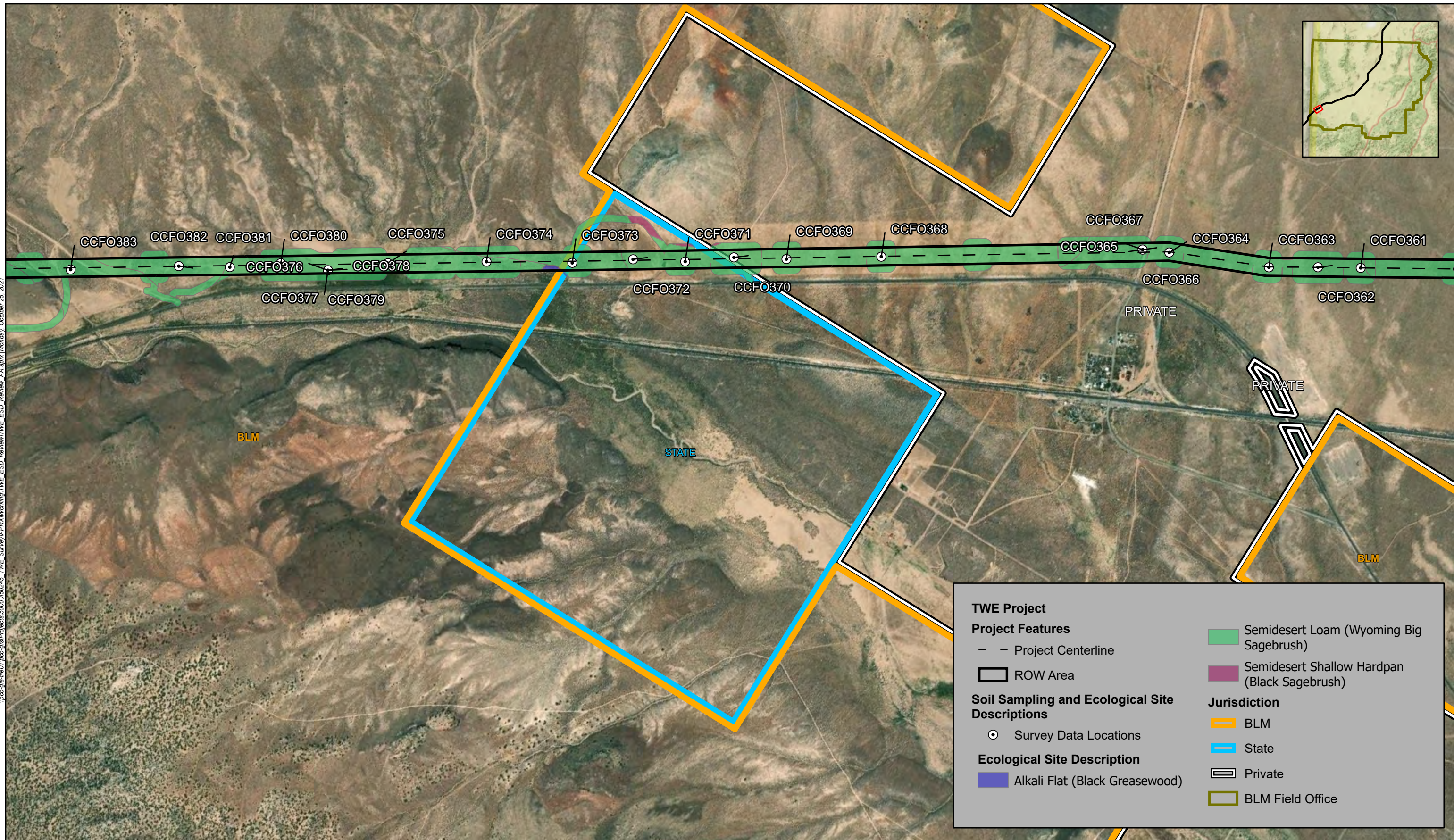
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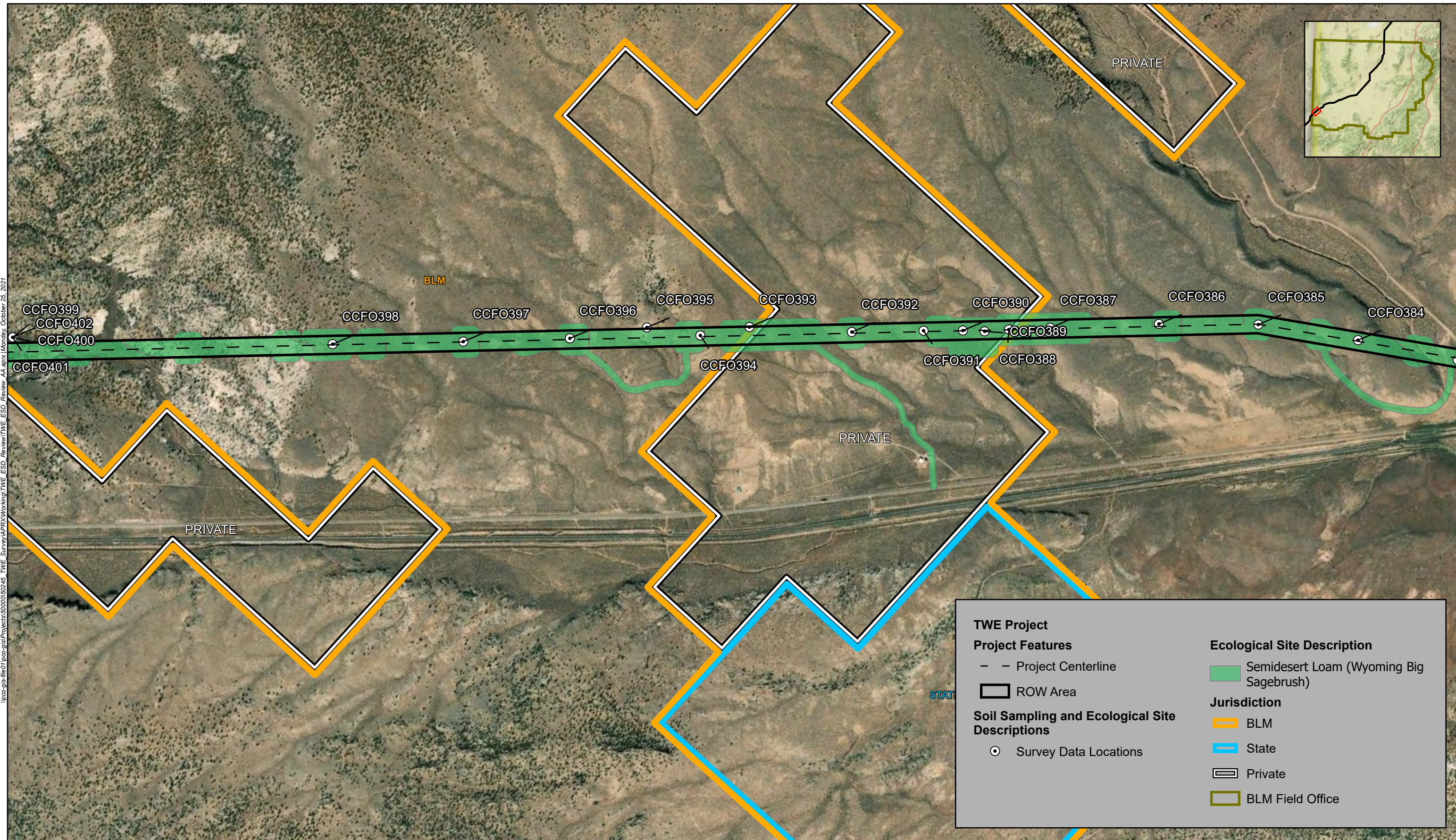
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Ecological Site Descriptions - Cedar City Field Office
TransWest Express Transmission Project



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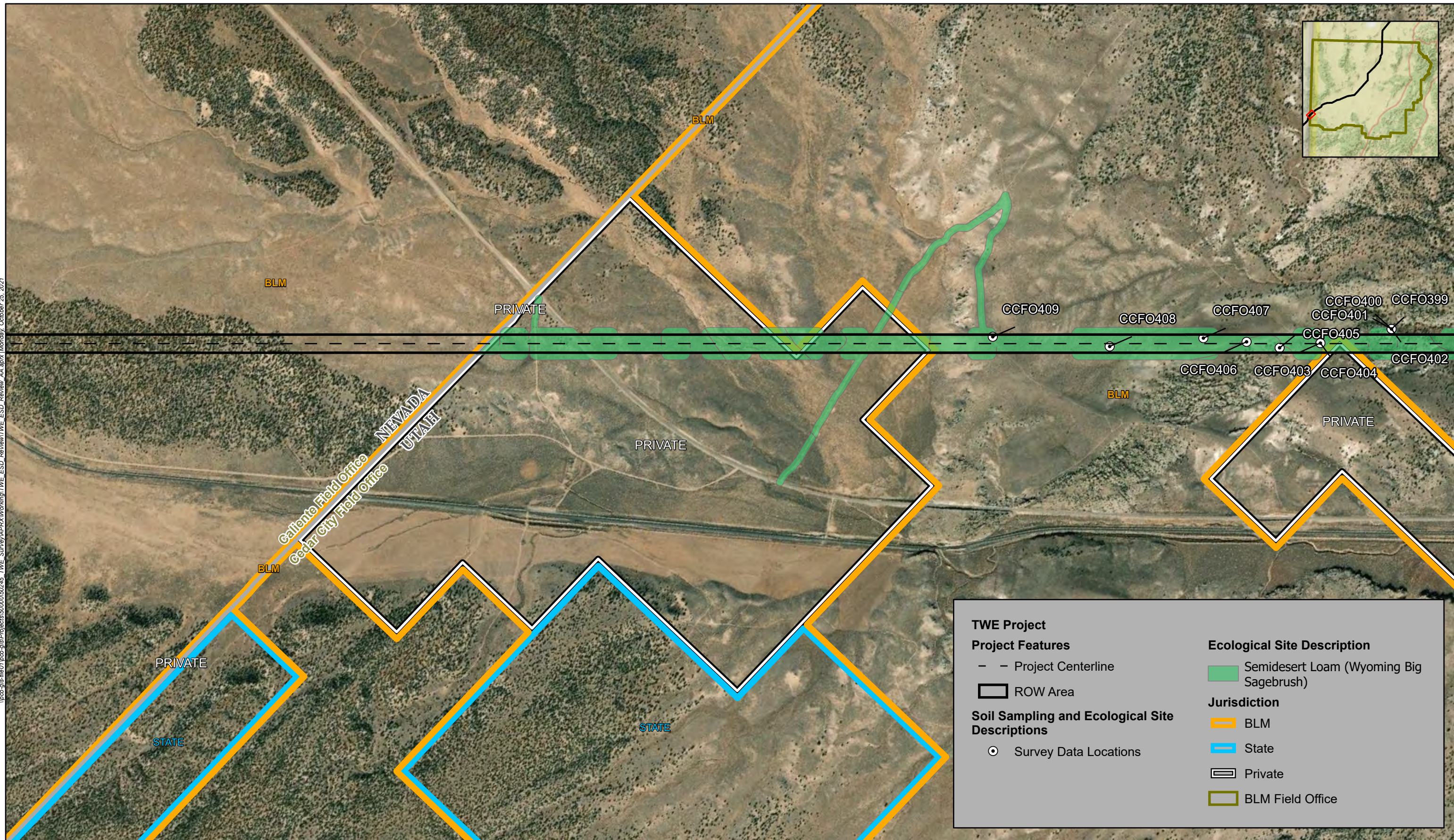
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Source: BLM 2015

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Ecological Site Descriptions - Cedar City Field Office
TransWest Express Transmission Project



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Ecological Site Descriptions - Cedar City Field Office
TransWest Express Transmission Project



APPENDIX H

Caliente Field Office Ecological Site Descriptions

1.0 ENVIRONMENTAL SETTINGS

1.1 Great Salt Lake Area Major Land Resource Area

In Nevada, the TransWest Express Transmission Project (TWE Project) is in the Great Salt Lake Area Major Land Resource Area (MLRA) (MLRA-28A). Elevation ranges from 3,950 to 6,560 feet (1,205 to 2,000 meters) in the basins and from 6,560 to 11,150 feet (2,000 to 3,400 meters) in the mountains. The average annual precipitation is 5 to 12 inches (125 to 305 millimeters) in the valleys and is as much as 49 inches (1,245 millimeters) in the mountains. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The driest period is from midsummer to early autumn. Precipitation in winter typically occurs as snow. The average annual temperature is 39 degrees Fahrenheit (°F) to 53°F (4 to 12 degrees Celsius). The frost-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with elevation. Water is scarce in this region. For the most part, streams are small and intermittent and depend on sources in the higher mountains. Reservoirs are used to store water in the mountains east of this area for irrigation in the flatter areas of this MLRA.

The dominant soil orders in the MLRA are Aridisols, Entisols, and Mollisols. The soils in the MLRA dominantly have a mesic or frigid soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are well drained or somewhat excessively drained, loamy or loamy-skeletal, and very deep. Calcixerolls formed in alluvium on alluvial fan remnants and lake terraces (Abela series) and in alluvium and lacustrine sediments on lake terraces (Collinston series). Moderately deep Haploxerolls (Middle series) formed in residuum on mountain slopes. Deep and very deep Haploxerolls (Ririe and Rexburg series) formed in loess and silty alluvium on fans, terraces, foothills, and basalt plains. Shallow Haploxerolls (Hymas series) to very deep Haploxerolls (Hondoho series) formed in colluvium and residuum derived from limestone on mountains and foothills. Torriorthents formed in alluvium on alluvial fans and beach plains (Cliffdown series) and in alluvium mixed with lacustrine sediments on alluvial flats and fans, lake terraces, and lake plains (Timpie and Tooele series). Poorly drained Aquisalids (Saltair series) formed in alluvium and lacustrine sediments on lake plains and basin floors. Torripsamments (Yenrab series) formed in sandy eolian material on dunes. Haplocalcids formed in residuum on hills and mountains (shallow Amtoft series); in alluvium and colluvium on alluvial fans, terraces, and hills (Hiko Peak series); in mixed alluvium and lacustrine sediments on alluvial fans, terraces; and lake plains (Taylorsflat series); and in lacustrine sediments on lake terraces (Thiokol series). Natrargids (Skumpah series) formed in alluvium on alluvial fans and flats.

This area supports desert shrub, Sagebrush Semidesert, and woodland vegetation. In areas where the average annual precipitation is less than about 200 millimeters, the soils support shadscale saltbush (*Atriplex confertifolia*), winterfat (*Krascheninnikovia lanata*), black sagebrush (*Artemisia nova*), and associated grasses, such as Indian ricegrass (*Achnatherum hymenoides*) and squirreltail (*Elymus elymoides*). Greasewood (*Sarcobatus vermiculatus*) and Nuttall's saltbush (*Atriplex nuttallii*) grow on soils having a high content of salts or sodium. In areas where the average annual precipitation is 200 to 300 millimeters, the soils support big sagebrush (*Artemisia tridentata*), shadscale saltbush, winterfat, and associated grasses, such as bluebunch wheatgrass (*Pseudoroegneria spicata*), Indian ricegrass, and bluegrasses (*Poa* spp.). In areas where the average annual precipitation is more than 300 millimeters, the soils support Utah juniper (*Juniperus osteosperma*), singleleaf pinyon (*Pinus monophylla*), big sagebrush, bluebunch wheatgrass, bluegrasses, and needle and thread (*Hesperostipa comata*). A large, nearly barren area west of Great Salt Lake has a very sparse cover of pickleweed (*Salicornia* spp.), sapphire woollystar (*Eriastrum saphirinum*), seepweed (*Suaeda* spp.), and greasewood.

1.2 Southern Nevada Basin and Range Major Land Resource Area

In Nevada, the TWE Project is also located in the Southern Nevada Basin and Range MLRA (MLRA-29). Elevation ranges from 1,950 to 5,600 feet (595 to 1,705 meters) in the valleys. On some high mountain peaks, it is more than 9,400 feet (2,865 meters). The average annual precipitation is 3 to 12 inches (75 to 305 millimeters) in most of this area. It ranges from 12 to 29 inches (305 to 735 millimeters), however, on the higher mountain slopes. Summers are dry, but sporadic storms are common in July and August. The average annual temperature is 28°F to 72°F (-2 to 22 degrees Celsius), decreasing with elevation. The freeze-free period averages 205 days and ranges from 80 to 335 days, decreasing in length with elevation.

The dominant soil orders in this MLRA are Aridisols and Entisols. Mollisols also are important in the mountainous areas. The soils in the area dominantly have a mesic soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are very shallow to very deep, well drained or somewhat excessively drained, and loamy-skeletal or sandy-skeletal. Haplargids formed in alluvium on alluvial fans and fan piedmonts (Ardivey and Unsel series) and in residuum and colluvium on hills, mountains, and plateaus (Downeyville, Gabbvally, and Stewval series). Haplocalcids (Candelaria series) formed in alluvium on ballenas and fan piedmonts. Haplocambids (Koyen series) formed in alluvium on fan piedmonts and alluvial fans. Argidurids (Handpah and Zadvar series) and Haplodurids (Ursine series) formed in alluvium on fan piedmonts and fan remnants. Torriorthents formed in residuum and colluvium on hills and mountains (Blacktop, Kyler, and Pintwater series) and in alluvium on alluvial flats, fans, and fan piedmonts (Gynelle and Wardenot series). Torrifluvents (Cirac series) formed in alluvium on alluvial flats and fans. Shallow Argixerolls formed in residuum and colluvium on hills and mountains (Bellehelen series).

This area supports desert shrub vegetation. The major vegetation consists of fourwing saltbush (*Atriplex canescens*) and greasewood. Shadscale saltbush is widespread. It is associated with bud sagebrush (*Picrothamnus desertorum*), Bailey greasewood (*Sarcobatus baileyi*) (in the west), gray molly kochia (*Kochia americana*), spiny hopsage (*Grayia spinosa*), fourwing saltbush, winterfat, horsebrush (*Tetradymia* spp.), galleta (*Pleuraphis* spp.), and Indian ricegrass. On the warmer sites, shadscale saltbush is associated with burrobrush (*Ambrosia dumosa*), spiny menodora (*Menodora spinescens*), Joshua tree (*Yucca brevifolia*), and blackbrush (*Coleogyne ramosissima*). Black greasewood is dominant on low-lying saline-alkali soils. In areas of higher precipitation, big sagebrush and black sagebrush are common and are associated with Indian ricegrass and galleta (*Pleuraphis* spp.). Pinyon-juniper woodland is prevalent in the mountains. Associated plants include black sagebrush, big sagebrush, blackbrush, bitterbrush (*Purshia tridentata*), cliffrose (*Purshia* spp.), and other shrubs and a variety of grasses and forbs.

1.3 Mohave Basin and Range Major Land Resource Area

In Nevada, the TWE Project is also located in the Mojave Desert MLRA (MLRA-30). Elevation ranges from 282 feet (85 meters) below sea level in Death Valley to 3,950 feet (1,205 meters) above sea level in valleys and basins. The lowest elevation occurring on dry land in the world, 282 feet (85 meters) below sea level, occurs in the Badwater Basin in Death Valley. Some mountain ranges have peaks that exceed 11,100 feet (3,385 meters). The average annual precipitation is 2 to 8 inches (50 to 205 millimeters) in most of this extremely dry MLRA. It exceeds 37 inches (940 millimeters) in some scattered areas at the higher elevations in Nevada and southwestern Utah. These storms occur more frequently in the eastern part of the area, where they contribute more to soil moisture. Snow is not very common and usually is on the ground for very short periods at the lower elevations, but the highest elevations may have snow for several weeks at a time in the winter. The average annual snowfall ranges from nearly 0 inches in the lowest deserts to more than 30 inches (760 millimeters) at the highest elevations of the Spring Mountains directly west of Las Vegas. The average annual temperature ranges from 43°F (6 degrees Celsius) in the

highest mountains to 76°F (25 degrees Celsius) in areas along the Colorado River in California, Nevada, and Arizona.

The dominant soil orders in this MLRA are Aridisols and Entisols. The soils in the area dominantly have a thermic soil temperature regime, an aridic soil moisture regime, and mixed or carbonatic mineralogy. They generally are well drained to excessively drained, loamy-skeletal or sandy-skeletal, and shallow to very deep. Torriorthents formed in alluvium on fan pediments, alluvial fans, fan aprons, and floodplains (Arizo, Carrizo, Hesperia, and Yermo series) and in residuum and colluvium on limestone and dolomite hills and mountains (St. Thomas series), on volcanic hills and mountains (Sunrock series), and on granite hills and mountains (Dalvord and Goldroad series). Torripsamments (Cajon series), Haplocalcids (Gunsight, Huevi, Tonopah, and Weiser series), and Petrocalcids (Bard, Cave, and Mormon Mesa series) formed in alluvium on alluvial fans, fan aprons, mesas, and terraces.

This area supports thin strands of desert vegetation. Creosote bush (*Larrea tridentata*), burrobrush, Joshua tree, juniper (*Juniperus* spp.), yucca (*Yucca* spp.), cactus, and mormon tea (*Ephedra viridis*) are the major species. Numerous annual forbs and grasses grow during years of favorable moisture. Fourwing saltbush, saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), and iodinebush (*Allenrolfea occidentalis*) grow on alkali flats. Indian ricegrass, Joshua tree, desert needlegrass (*Stipa speciosa*), and galleta grow on sandy soils.

1.4 Ecological Site Distribution

Dominant ecological sites in the TWE Project right-of-way within the Caliente City Field Office (FO) include Coarse Gravelly Loam 5–8 P.Z. (403.3 acres) and Pinyon-Juniper (395.1 acres). Less prevalent ecological sites include Sandhill (4.7 acres) and Loamy Bottoms 8–12 P.Z (8.8 acres). All ecological sites are located within BLM managed lands (Table H-1). A photograph of each ecological site is provided in Attachment H-1. Maps depicting the ecological site locations in the TWE Project right-of-way are provided in Attachment H-2.

TABLE H-1 ECOLOGICAL SITE DISTRIBUTION IN THE BLM CALIENTE FO

Ecological Site*	Managing Agency	Right-of-Way Area (acres)	Permanent Disturbance Area (acres)	Temporary Work Area (acres)
Desert Fans		273	6	199
Desert Fans 4–6 P.Z.	BLM	273	6	199
Limy Hills		70	2	59
Limy Hills 5–7 P.Z.	BLM	70	2	59
Loams		470	8	298
Coarse Gravelly Loam 5–8 P.Z.	BLM	404	6	240
Loamy 10–12 P.Z.	BLM	57	2	50
Loamy Bottoms 8–12 P.Z.	BLM	9	<1	8
Sands		5<1		4
Sandhill	BLM	5	<1	4
Stony Slopes		554	13	410
North Slope 12–14 P.Z.	BLM	30	1	26
Pinyon-Juniper	BLM	399	9	309
Shallow Calcareous Slope 8–10 P.Z.	BLM	35	1	12
Shallow Clay Loam 10–14 P.Z.	BLM	90	2	62

* P.Z. = Precipitation zone (inches)

1.5 Rangeland Analysis Platform

RAP was used to further assess the distribution and estimated cover of vegetation and cover types across the Project (NRCS and BLM 2021). RAP integrates data from NRCS's National Resources Inventory and BLM's Assessment, Inventory, and Monitoring and Landscape Monitoring Framework datasets. These quantitative vegetative assessments are modeled with historical Landsat satellite records, gridded meteorology data, and abiotic land surface data to provide estimates of the percent vegetation cover of different growth forms. RAP data were used to define the vegetation and abiotic characteristics for the Project and to develop reclamation success cover standards for each ecological site and DRG, as defined in Table H-2.

TABLE H-2 DRG RAP ATTRIBUTE DATA FOR THE BLM CEDAR CITY FO

DRG	ESD	Forbs and Grasses - Annuals (%)	Forbs and Grasses - Perennial (%)	Woody (%)	Litter (%)	Bareground (%)
Desert Fans	Desert Fans	20.2	5.5	12.5	13.5	28.4
	SUBTOTAL	20.2	5.5	12.5	13.5	28.4
Limy Hills	Limy Hills	14.0	4.7	13.7	11.4	27.2
	SUBTOTAL	14.0	4.7	13.7	11.4	27.2
Loams	Coarse Gravelly Loam	20.2	4.7	14.0	12.6	24.4
	Loamy	4.7	7.6	31.5	15.9	20.8
	Loamy Bottoms	4.5	9.5	21.7	12.6	30.9
	SUBTOTAL	9.8	7.2	22.4	13.7	25.4
Sands	Sandhill	21.0	4.2	10.8	12.1	30.1
	SUBTOTAL	21.0	4.2	10.8	12.1	30.1
Stony Slopes	North Slope	6.4	8.8	37.3	14.4	8.7
	Pinyon-Juniper	5.5	6.2	36.5	15.1	12.3
	Shallow Calcareous Slope	3.3	6.2	29.7	14.5	23.1
	Shallow Clay Loam	4.6	7.2	29.6	14.6	20.6
	SUBTOTAL	4.9	7.1	33.3	14.6	16.2

Source: NRCS and BLM 2021

2.0 INDIVIDUAL ECOLOGICAL SITE DESCRIPTIONS

2.1 Desert Fans 4–6 P.Z. Ecological Site Description

Desert Fans 4–6 P.Z. ecological sites in the TWE Project within the Caliente FO occur extensively in the Mojave Desert and typically occur on fan piedmonts, broad alluvial fans, and fan remnants on all exposures. Slopes in this site range from 2% to 30%, but slope gradients of 2% to 15% are typical (Natural Resources Conservation Service [NRCS] 2011). Major soil series associated with Desert Fans 4–6 P.Z. ecological sites include Underton, Baseline, Gaurdian, Arada, Bluepoint, Tipnat, Akela, Haleburu, Stand Grapevine soil series. The climate in Desert Fans 4–6 P.Z. ecological sites is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. The climate is arid and is characterized by cool, moist winters and hot, dry summers. The relative humidity is low, evaporation is high, the percentage of sunshine is high, and the daily and seasonal range in temperature is wide. The average annual precipitation ranges from 5 to 8 inches.

2.1.1 Soil Characteristics

Desert Fans 4–6 P.Z. ecological sites are characterized as shallow to moderately deep, runoff is typically low to medium, permeability is moderate to moderately rapid, and soils are typically well drained to excessively drained (Table H-3; NRCS 2020a). Topsoil textures include very gravelly fine sandy loam, very gravelly loamy sand, and very gravelly loam. Average topsoil depth is approximately 2.7 ± 1.7 inches. Soil depth to a layer restrictive to root development, such as a petrocalcic horizon, is greater than 10 inches. Subsoil textures are characterized by loam to silty clay loam (NRCS 2020a). Soil pH ($\text{pH} > 8.4$), salinity (electrical conductivity $[\text{EC}] > 4.0$ deciSiemens per meter $[\text{dS/m}]$), and sodicity (sodium adsorption ratio $[\text{SAR}] > 12.0$) may limit vegetation growth in some areas (see Table H-3).

TABLE H-3 SOIL CHARACTERISTICS TYPICAL OF CLAYEY 7–9 INCH ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in mixed alluvium
Topsoil depth	2.7 ± 1.7 inches
Topsoil texture	Very gravelly fine sandy loam, very gravelly loamy sand, and very gravelly loam
Topsoil fragments	5%–90%
Topsoil pH	7.9–9.0
Topsoil salinity (EC)	0–8 dS/m
Topsoil sodicity (SAR)	0–30
Subsoil texture	Sandy loam to loam
Subsoil fragments	4%–69%
Subsoil pH	7.9–9.0
Subsoil salinity (EC)	0–8 dS/m
Subsoil sodicity (SAR)	0–30

Source: NRCS (2020a, 2020d)

2.1.2 Vegetation

Vegetative composition by growth forms in Desert Fans 4–6 P.Z. ecological sites is approximately 80% shrubs, 10% grasses and grass-like plants, and 10% forbs (Table H-4; NRCS 2020a). The dominant grasses that may occur in Desert Fans ecological sites include big galleta (*Pleuraphis rigida*) (NRCS 2020a). Secondary grasses that may occur include Indian ricegrass, desert needlegrass (*Achnatherum speciosum*), threeawn (*Aristida*), and sixweeks grama (*Bouteloua barbata*). Dominant woody plants found at this site include burrobush, creosote bush, littleleaf ratany (*Krameria erecta*), and Nevada jointfir (*Ephedra nevadensis*). Secondary woody species include shadscale saltbush, brittlebush (*Encelia farinosa*), winterfat, desert-thorn (*Lycium*), Fremont’s dalea (*Psoralea fremontii*), and Mojave yucca (*Yucca schidigera*).

TABLE H-4 VEGETATION CHARACTERISTICS TYPICAL DESERT FANS 4–6 P.Z. ECOLOGICAL SITES

Growth Form	Composition
Grasses	10%
Forbs	10%
Shrubs	80%

Source: NRCS (2020a)

2.2 Limy Hills 5–7 P.Z. Ecological Site Description

Limy Hills 5–7 P.Z. ecological sites in the TWE Project within the Caliente FO occur on fan remnants and alluvial fans on all exposures. Slopes range from 0% to 15%, but slope gradients of 2% to 8% are typical (NRCS 2020a). Major soil series associated with Limy Hills ecological sites include Aymate, Canoto, St. Thomas, and Zeheme. The climate in Limy Hills ecological sites is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. The climate is arid and is characterized by cool, moist winters and hot, dry summers. The relative humidity is low, evaporation is high, the percentage of sunshine is high, and the daily and seasonal range in temperature is wide. The average annual precipitation ranges from 3 to 5 inches.

2.2.1 Soil Characteristics

Limy Hills 5–7 P.Z. ecological sites are characterized by very deep soils, permeability is rapid to very rapid, and soils are typically well drained to excessively drained (Table H-5; NRCS 2020a). Desert pavement is common throughout this ecological site. Topsoil textures include gravelly fine sandy loam, very gravelly loamy sand, and very gravelly loamy coarse sand. Average topsoil depth is approximately 2.6 ± 0.7 inches. Subsoil textures are characterized by sandy loam to loam. Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table H-5).

TABLE H-5 SOIL CHARACTERISTICS TYPICAL OF LIMY HILLS 5–7 P.Z. ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in mixed alluvium
Topsoil depth	2.6 ± 0.7 inches
Topsoil texture	Gravelly fine sandy loam, very gravelly loamy sand, and very gravelly loamy coarse sand
Topsoil fragments	15%–65%
Topsoil pH	7.9–8.4
Topsoil salinity (EC)	0–16 dS/m
Topsoil sodicity (SAR)	0–10
Subsoil texture	Sandy loam to loam
Subsoil fragments	10%–65%
Subsoil pH	7.9–9.0
Subsoil salinity (EC)	0–16 dS/m
Subsoil sodicity (SAR)	0–10

Sources: NRCS (2020a, 2020d)

2.2.2 Vegetation

Vegetative composition by growth forms in Limy Hills 5–7 P.Z. ecological sites is approximately 90% woody species, 5% grasses and grass-like plants, and 5% forbs (Table H-6; NRCS 2020a). The dominant grasses that may occur in Limy Hills 5–7 P.Z. ecological sites include big galleta, Indian ricegrass, threeawn, and low woollygrass (*Dasyochloa pulchella*). Dominant woody plants found at this site include creosote bush and burrobush. Secondary woody species include brittlebush and Fremont's dalea.

TABLE H-6 VEGETATION CHARACTERISTICS TYPICAL OF LIMY HILLS 3–5 P.Z. ECOLOGICAL SITES

Growth Form	Composition
Grasses	5%
Forbs	5%
Shrubs	90%

Source: NRCS (2020a)

2.3 Loamy Bottoms 8–12 P.Z. Ecological Site Description

Loamy Bottom 8–12 P.Z. ecological sites in the TWE Project within the Caliente FO occur on drainageways in mountains on slopes with a gradient of 0% to 8% (NRCS 2020a). Major soil series associated with Loamy Bottoms 8–12 P.Z. ecological sites include Deerlodge, Fanu, and Newvil. The climate in Loamy Bottoms 8–12 P.Z. ecological sites is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. The climate is arid and is characterized by cool, moist winters and hot, dry summers. The average annual precipitation ranges from 10 to 14 inches.

2.3.1 Soil Characteristics

Loamy Bottoms 8–12 P.Z. ecological sites are characterized as very deep and very well drained (Table H-7; NRCS 2020a). They are formed in limestone and minor amounts of quartzite. Additional moisture is received on this site as overflow from adjacent streams or as run-in from higher landscapes. These soils are susceptible to gully formation, which will intercept natural overland flow patterns causing site degradation. Topsoil textures are considered loamy. Average topsoil depth is approximately 4.6 ± 4.4 inches. Soil depth to a layer restrictive to root development, such as a petrocalcic horizon, is greater than 10 inches. Subsoil textures are characterized as loamy. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table H-7).

TABLE H-7 SOIL CHARACTERISTICS TYPICAL OF LOAMY BOTTOMS 8–12 P.Z. ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in limestone and minor amounts of quartzite
Topsoil depth	4.6 ± 4.4 inches
Topsoil texture	Loamy
Topsoil fragments	0%–5%
Topsoil pH	7.8–8.7
Topsoil salinity (EC)	0 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Loamy
Subsoil fragments	5%–10%
Subsoil pH	7.9–9.0
Subsoil salinity (EC)	0 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.3.2 Vegetation

Vegetative composition by growth forms in Loamy Bottoms ecological sites is approximately 75% shrubs, 20% grasses and grass-like plants, and 5% forbs (Table H-8; NRCS 2020a). The dominant grasses that may occur in Loamy Bottoms ecological sites include basin wildrye (*Leymus cinereus*) and western wheatgrass (*Pascopyrum smithii*). Secondary grasses that may occur include blue grama, sedge (*Carex* spp.), squirreltail, and bluebunch wheatgrass. The dominant woody plant found at this site is basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). Subdominant woody plants include rubber rabbitbrush (*Ericameria nauseosa*), currant (*Ribes*), Woods' rose (*Rosa woodsii*), and willow (*Salix*) (NRCS 2020a).

TABLE H-8 VEGETATION CHARACTERISTICS TYPICAL OF LOAMY BOTTOMS 8–12 P.Z. ECOLOGICAL SITES

Growth Form	Composition
Grasses	20%
Forbs	5%
Shrubs	75%

Source: NRCS (2020a)

2.4 Coarse Gravelly Loams 5–8 P.Z. Ecological Site Description

Coarse Gravelly Loams 5–8 P.Z. ecological sites in the TWE Project within the Caliente FO occur on barrier beaches, fan remnants, and alluvial flats on all exposures. Slopes range from 0% to 30%, but slope gradients of 2% to 15% are most typical (NRCS 2020a). Major soil series associated with Coarse Gravelly Loams 5–8 P.Z. ecological sites include Veet, Cedar, Wakansapa, Turba, Decan, Acoma, and Uana. The climate in Coarse Gravelly Loams 5–8 P.Z. ecological sites is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. The climate is arid and is characterized by cool, moist winters and hot, dry summers. The average annual precipitation ranges from 5 to 8 inches.

2.4.1 Soil Characteristics

Coarse Gravelly Loams 5–8 P.Z. ecological sites are characterized as deep, runoff is typically low to high, permeability is slow to very rapid, and soils are typically well drained to somewhat excessively drained (Table H-9; NRCS 2020a). Topsoil textures include extremely gravelly sand, very gravelly loam, and gravelly loam. Average topsoil depth is approximately 2.3 ± 1.5 inches. These soils are moderately to strongly alkaline and calcareous and there are high volumes of rock fragments throughout the soil profile. Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table H-9).

TABLE H-9 SOIL CHARACTERISTICS TYPICAL OF COARSE GRAVELLY LOAMS 5–8 P.Z. ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium from mixed rock sources which are influenced by calcareous loess
Topsoil depth	2.3 ± 1.5 inches
Topsoil texture	Extremely gravelly sand, very gravelly loam, and gravelly loam
Topsoil fragments	40%–60%
Topsoil pH	8.6–9.6
Topsoil salinity (EC)	2–4 dS/m

Soil Characteristics	Description
Topsoil sodicity (SAR)	5–30
Subsoil texture	Loam
Subsoil fragments	35%–75%
Subsoil pH	8.9–9.6
Subsoil salinity (EC)	2–4 dS/m
Subsoil sodicity (SAR)	5–30

Sources: NRCS (2020a, 2020d)

2.4.2 Vegetation

Vegetative composition by growth forms in Coarse Gravelly Loams 5–8 P.Z. ecological sites is approximately 40% shrubs, 55% grasses and grass-like plants, and 5% forbs (Table H-10; NRCS 2020a). The dominant grasses that may occur in Gravelly Loams ecological sites include Indian ricegrass, needle and thread, James' galleta, and sand dropseed (*Sporobolus cryptandrus*). Secondary grasses that may occur include King's eyelashgrass (*Blepharidachne kingii*), squirreltail, and Sandberg bluegrass. Dominant woody plants found at this site include shadscale saltbush, winterfat, and bud sagebrush. Secondary woody species include fourwing saltbush, yellow rabbitbrush, Nevada jointfir, spiny hopsage, broom snakeweed (*Gutierrezia sarothrae*), and horsebrush (NRCS 2020a).

TABLE H-10 VEGETATION CHARACTERISTICS TYPICAL OF COARSE GRAVELLY LOAMS 5–8 P.Z. ECOLOGICAL SITES

Growth Form	Composition
Grasses	55%
Forbs	5%
Shrubs	40%

Source: NRCS (2020a)

2.5 Loamy 10–12 Inch Ecological Site

Loamy 10–12 Inch ecological sites in the TWE Project within the Caliente FO occur on rolling hills and fan piedmonts on all exposures (NRCS 2020a). Major soil series include Badena, Basket, Bluemass, Decan, Ravendog, and Zafod. The mean annual precipitation ranges from 10 to about 12 inches per year in Loamy 10–12 Inch ecological sites and precipitation typically falls in August and ends by October (NRCS 2020a).

2.5.1 Soil Characteristics

Loamy 10–12 Inch ecological sites are characterized by moderately deep to very deep with well-drained soils (Table H-11; NRCS 2020a, 2020d). Topsoil textures range from gravelly sandy loam to very cobbly fine sandy loam, and depth averages approximately 6.0 ± 0.0 inches. Subsoil textures are characterized by sandy loam. Gravels may be present throughout the profile (NRCS 2020a, 2020d). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table H-11).

TABLE H-11 SOIL CHARACTERISTICS TYPICAL OF LOAMY 10–12 INCH ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium from mixed rock parent materials
Topsoil depth	6.0 ± 0.0 inches
Topsoil texture	Extremely stony loam, gravelly loam, extremely channery clay loam
Topsoil fragments	15%–20% sandstones; 0%–15% channers
Topsoil pH	7.4–7.8
Topsoil salinity (EC)	0 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Sandy loam
Subsoil fragments	15%–50% gravel; 0%–40% channers
Subsoil pH	7.4–7.8
Subsoil salinity (EC)	0 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.5.2 Vegetation

Potential foliar vegetation cover in Loamy 10–12 Inch ecological sites by growth form composition is 60% grasses or grass-like plants, 5% forbs, and 35% woody plants (Table H-12; NRCS 2020a).

The major grasses include needle and thread, bluebunch wheatgrass, Indian ricegrass, and Thurber's needlegrass (*Achnatherum thurberianum*). Woody species include fourwing saltbush, yellow rabbitbrush (*Chrysothamnus viscidiflorus*), jointfir (*Ephedra* spp.), Utah juniper, and winterfat (NRCS 2020a).

TABLE H-12 VEGETATION CHARACTERISTICS TYPICAL OF LOAMY 10–12 INCH ECOLOGICAL SITES

Growth Form	Composition
Grasses	60%
Forbs	5%
Shrubs	35%

Source: NRCS (2020a)

2.6 Sandhill Ecological Site Description

Sandhill ecological sites in the TWE Project within the Caliente FO occur on sand sheets, fan skirts, and fan remnants on all exposures. Slopes range from 0% to 15% (NRCS 2020a). Major soil series associated with Sandy 5–8 P.Z. ecological sites include St Thomas soil series. The climate in Sandhill ecological sites is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. The climate is arid and is characterized by cool, moist winters and hot, dry summers. The average annual precipitation ranges from 5 to 8 inches.

2.6.1 Soil Characteristics

Sandhill ecological sites are characterized as very shallow to very deep, permeability is rapid, and soils are well drained to somewhat excessively drained (Table H-13; NRCS 2020a). Topsoil textures include very gravelly loam, gravelly sandy loam, and very gravelly fine sandy loam. Average topsoil depth is

approximately 2.0 ± 0.0 inches. These soils are fragile and subject to wind erosion if misused. Subsoil textures are characterized as loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table H-13).

TABLE H-13 SOIL CHARACTERISTICS TYPICAL OF SANDHILL WASH ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Mixed origin
Topsoil depth	2.0 ± 0.0 inches
Topsoil texture	Very gravelly loam, gravelly sandy loam, and very gravelly fine sandy loam
Topsoil fragments	2%–23%
Topsoil pH	6.6–9.6
Topsoil salinity (EC)	0–32 dS/m
Topsoil sodicity (SAR)	0–60
Subsoil texture	Loam
Subsoil fragments	24%–47%
Subsoil pH	6.9–9.6
Subsoil salinity (EC)	0–32 dS/m
Subsoil sodicity (SAR)	0–60

Sources: NRCS (2020a, 2020d)

2.6.2 Vegetation

Vegetative composition by growth forms in Sandhill ecological sites is approximately 25% shrubs, 70% grasses and grass-like plants, and 5% forbs (Table H-14; NRCS 2020a). The dominant grasses that may occur in Shallow Loams ecological sites include Indian ricegrass, sand dropseed, and needle and thread. Secondary grasses that may occur include threeawn, squirreltail, James' galleta, spike dropseed (*Sporobolus contractus*) and mesa dropseed (*Sporobolus flexuosus*). Dominant woody plants found at this site include fourwing saltbush and winterfat. Secondary woody species include shadscale saltbush, yellow rabbitbrush, Nevada jointfir, spiny hopsage, bud sagebrush, Nevada dalea (*Psoralea polydenius*), and horsebrush (NRCS 2020a).

TABLE H-14 VEGETATION CHARACTERISTICS TYPICAL OF SANDHILL WASH ECOLOGICAL SITES

Growth Form	Composition
Grasses	70%
Forbs	5%
Shrubs	25%

Source: NRCS (2020a)

2.7 North Slope 12–14 Ecological Site

North Slope 12–14 ecological sites in the TWE Project within the Caliente FO occur on mountain side slopes of mostly northerly aspect at the lower elevations of its range and on all aspects at higher elevations. (NRCS 2020a). Major soil series include Capsus and Slidymtn. The mean annual precipitation ranges from 8 to 10 inches per year in North Slope 12–14 ecological sites and typically falls March through October (NRCS 2020a).

2.7.1 Soil Characteristics

North Slope 12–14 ecological sites are characterized by shallow to very shallow to bedrock or a cemented layer and are well drained (Table H-15; NRCS 2020a, 2020d). Topsoil textures include very cobbly clay loam and very gravelly sandy loam, and depth averages approximately 14.0 ± 6.0 inches. Subsoil textures are characterized as loamy (NRCS 2020a, 2020d). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table H-15).

TABLE H-15 SOIL CHARACTERISTICS TYPICAL OF NORTH SLOPE 12–14 ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in residuum
Topsoil depth	14.0 ± 6.0 inches
Topsoil texture	Extremely stony loam, gravelly loam, extremely channery clay loam
Topsoil fragments	23%–30% sandstones; 10%–30% channers
Topsoil pH	6.6–7.8
Topsoil salinity (EC)	0 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Loamy
Subsoil fragments	24%–36% gravel; 5%–21% channers
Subsoil pH	6.6–7.8
Subsoil salinity (EC)	0 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.7.2 Vegetation

Potential foliar vegetation cover in North Slope 12–14 ecological sites by growth form composition is 35% grasses or grass-like plants, 10% forbs, and 55% woody plants (Table H-16; NRCS 2020a). The major grasses include muttongrass (*Poa fendleriana*), Sandberg bluegrass, and blue gramma (*Bouteloua gracilis*). Woody species include Gamble oak (*Quercus gambelii*), singleleaf pinyon (*Pinus monophylla*), Utah juniper, Utah serviceberry (*Amelanchier utahensis*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), and Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) (NRCS 2020a).

TABLE H-16 VEGETATION CHARACTERISTICS TYPICAL OF NORTH SLOPE 12–14 ECOLOGICAL SITES

Growth Form	Composition
Grasses	35%
Forbs	10%
Shrubs	55%

Source: NRCS (2020a)

2.8 Pinyon-Juniper Ecological Site Description

Pinyon-Juniper, ecological sites in the TWE Project within the Caliente FO occur on steep mountain sideslopes on all aspects. Slopes are typically 15% to 50% (NRCS 2020a). Major soil series associated

with Pinyon-Juniper ecological sites include Motoqua, Thunderbird, Turba, Acti, Wakansapa, Cedaran, Stewval, Gabbvally, Zauqua, and Winklo. The climate in Pinyon-Juniper ecological sites is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. The climate is arid and is characterized by cool, moist winters and hot, dry summers. The average annual precipitation ranges from 12 to 16 inches.

2.8.1 Soil Characteristics

Pinyon-Juniper ecological sites are characterized as shallow, permeability is moderately slow to moderate, and soils are somewhat poorly drained (Table H-17; NRCS 2020a). Topsoil textures include very gravelly loam and very cobbly loam. Average topsoil depth is approximately 1.6 ± 0.3 inches. There are high amounts of rock fragments at the soil surface which occupy plant growing space yet help to reduce evaporation and conserve soil moisture. Subsoil textures are characterized as loam. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table H-17).

TABLE H-17 SOIL CHARACTERISTICS TYPICAL OF PINYON-JUNIPER ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in residuum and colluvium from limestone and dolomitic limestone
Topsoil depth	1.6 ± 0.3 inches
Topsoil texture	Very gravelly loam and very cobbly loam
Topsoil fragments	30%–45%
Topsoil pH	7.4–8.4
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–2
Subsoil texture	Loam
Subsoil fragments	20%–45%
Subsoil pH	7.4–8.6
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0–2

Sources: NRCS (2020a, 2020d)

2.8.2 Vegetation

Vegetative composition by growth forms in Pinyon-Juniper ecological sites is approximately 75% shrubs, 20% grasses and grass-like plants, and 5% forbs (Table H-18; NRCS 2020a). The dominant grasses that may occur in Stony Slopes ecological sites include muttongrass. Secondary grasses that may occur include Sandberg bluegrass, Indian ricegrass, desert needlegrass, squirreltail, and needle and thread. Dominant woody plants found at this site include ashy silktassel (*Garrya flavescens*), Utah serviceberry, mountain big sagebrush, and Wyoming big sagebrush. Secondary woody species include mormon tea, Apache plume (*Fallugia paradoxa*), pricklypear (*Opuntia* spp.), desert bitterbrush (*Purshia glandulosa*), and Stansbury cliffrose. Singleleaf pinyon and Utah juniper are also present at these sites (NRCS 2020a).

TABLE H-18 VEGETATION CHARACTERISTICS TYPICAL OF DESERT PINYON-JUNIPER ECOLOGICAL SITES

Growth Form	Composition
Grasses	20%
Forbs	5%
Shrubs	75%

Source: NRCS (2020a)

2.9 Shallow Calcareous Slope 8–10 Inch Ecological Site

Shallow Calcareous Slope 8–10 Inch ecological sites in the TWE Project within the Caliente FO occur on summits and sideslopes of hills, mountains, and fan remnants on all exposures (NRCS 2020a). Major soil series include Arnespan, Chubard, Eastmore, Holborn, Jericho, Jungo, Kyler, Lomoiné, Pibler, Stewval, Tarnach, Ursine, and Wala. The mean annual precipitation ranges from 8 to 10 inches per year in Shallow Calcareous Slope 8–10 Inch ecological sites and typically falls March through October (NRCS 2020a).

2.9.1 Soil Characteristics

Shallow Calcareous Slope 8–10 Inch ecological sites are characterized by shallow to very shallow to bedrock or a cemented layer and are well drained (Table H-19; NRCS 2020a, 2020d). Topsoil textures include extremely cobbly loam, and depth averages approximately 10.0 ± 1.00 inches. Subsoil textures are characterized as loamy (NRCS 2020a, 2020d). Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table H-19).

TABLE H-19 SOIL CHARACTERISTICS TYPICAL OF SHALLOW CALCAREOUS SLOPE 8–10 INCH ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in residuum and colluvium from limestone and dolomite
Topsoil depth	10.0 ± 1.0 inches
Topsoil texture	Extremely stony loam, gravelly loam, extremely channery clay loam
Topsoil fragments	23%–35% sandstones; 30%–40% channers
Topsoil pH	7.9–8.6
Topsoil salinity (EC)	0 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Loamy
Subsoil fragments	15%–35% gravel; 10%–30% channers
Subsoil pH	7.9–8.6
Subsoil salinity (EC)	0 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.9.2 Vegetation

Potential foliar vegetation cover in Shallow Calcareous Slope 8–10 Inch ecological sites by growth form composition is 40% grasses or grass-like plants, 5% forbs, and 55% woody plants (Table H-20; NRCS 2020a). The major grasses include needle and thread, Indian ricegrass, James' galleta (*Pleuraphis*

jamesii), and Sandberg bluegrass (*Poa secunda*). Woody species include black sagebrush, winterfat, shadscale saltbush, and globemallow (*Sphaeralcea* spp.) (NRCS 2020a).

TABLE H-20 VEGETATION CHARACTERISTICS TYPICAL OF VERY SHALLOW CALCAREOUS SLOPE 8–10 INCH ECOLOGICAL SITES

Growth Form	Composition
Grasses	40%
Forbs	5%
Shrubs	55%

Source: NRCS (2020a)

2.10 Shallow Clay Loam 10–14 P.Z. Ecological Site Description

Shallow Clay Loam 10–14 P.Z. ecological sites in the TWE Project within the Caliente FO occur on ridges and sideslopes of upper fan remnant slopes, hills, and mountains on all exposures. Slopes range from 2% to 75%, but slope gradients of 2% to 30% are most typical (NRCS 2020a). Major soil series associated with Shallow Clay Loam 10–14 P.Z. ecological sites include Decan, Acoma, and Uana. The climate in Shallow Clay Loam 10–14 P.Z. ecological sites is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. The climate is arid and is characterized by cool, moist winters and hot, dry summers. The average annual precipitation ranges from 8 to 14 inches.

2.10.1 Soil Characteristics

Shallow Clay Loam 10–14 P.Z. ecological sites are characterized as very shallow to shallow, permeability is moderately slow to moderately rapid, and soils are well drained (Table H-21; NRCS 2020a). These soils are often modified with high amounts of gravels, cobbles, or stones on the surface that occupy plant growing space and reduce the potential soil moisture holding capacity. Topsoil textures include gravelly loam, very gravelly fine sandy loam, and very stony fine sandy loam. Average topsoil depth is approximately 2.6 ± 1.3 inches. These soils are moderately to strongly alkaline and calcareous and there are high volumes of rock fragments throughout the soil profile. Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table H-21).

TABLE H-21 SOIL CHARACTERISTICS TYPICAL OF SHALLOW CLAY LOAM 10–14 P.Z. ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium from mixed rock sources which are influenced by calcareous loess
Topsoil depth	2.6 ± 1.3 inches
Topsoil texture	Gravelly loam, very gravelly fine sandy loam, and very stony fine sandy loam
Topsoil fragments	30%–60%
Topsoil pH	6.6–9.6
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–5
Subsoil texture	Loam
Subsoil fragments	24%–47%
Subsoil pH	6.9–9.6

Soil Characteristics	Description
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0–5

Sources: NRCS (2020a, 2020d)

2.10.2 Vegetation

Vegetative composition by growth forms in Shallow Clay Loam 10–14 P.Z. ecological sites is approximately 40% shrubs, 55% grasses and grass-like plants, and 5% forbs (Table H-22; NRCS 2020a). The dominant grasses that may occur in Shallow Clay Loam ecological sites include Indian ricegrass, Thurber’s needlegrass, needle and thread, muttongrass, and blue grama. Secondary grasses that may occur include pine needlegrass (*Achnatherum pinetorum*), squirreltail, James’ galleta, and Sandberg bluegrass. Dominant woody plants found at this site include black sagebrush and Nevada jointfir. Secondary woody species include fourwing saltbush, yellow rabbitbrush, winterfat, Stansbury cliffrose (*Purshia stansburiana*), and antelope bitterbrush. Utah juniper and singleleaf pinyon are also present.

TABLE H-22 VEGETATION CHARACTERISTICS TYPICAL SHALLOW CLAY LOAM 10–14 P.Z. ECOLOGICAL SITES

Growth Form	Composition
Grasses	55%
Forbs	5%
Shrubs	40%

Source: NRCS (2020a)

ATTACHMENT H-1

Caliente Field Office Photographs



Figure H-1-1 Representative Coarse Gravelly Loam 5-8 P.Z. in the Caliente FO. Site ID 1216rd09.



Figure H-1-2 Representative Desert Fans 4-6 P.Z. in the Caliente FO. Site ID 1216mmt20.



Figure H-1-3 Representative Limy Hills 5-7 P.Z. in the Caliente FO. Site ID 1215rd14.



Figure H-1-4 Representative Loamy 10-12 P.Z. in the Caliente FO. Site ID 1013rd01.



Figure H-1-5 Representative Loamy Bottoms 8–12 P.Z. in the Caliente FO. Site ID 1214dh14.



Figure H-1-6 Representative North Slope 12–14 in the Caliente FO. Site ID 0515cm03.



Figure H-1-7 Representative PIMO-JUOS/ARTRV 12-16 P.Z. in the Caliente FO. Site ID 0329rd09.



Figure H-1-8 Representative Sandy 5-8 P.Z. in the Caliente FO. Site ID 1218MMT06.



Figure H-1-9 Representative Shallow Calcareous Slope 8–10 P.Z. in the Caliente FO.
Site ID 1217RD01.



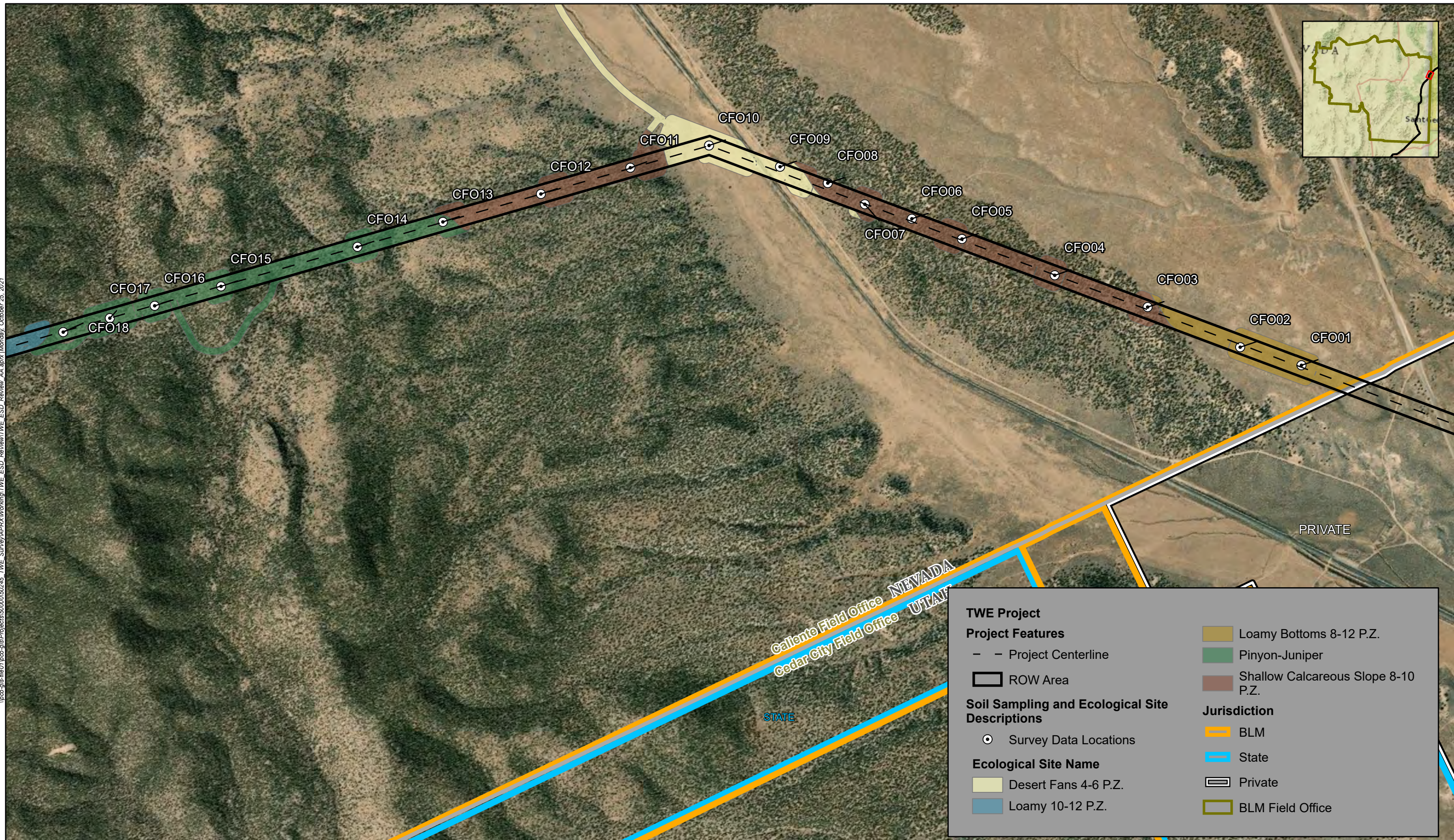
Figure H-1-10 Representative Shallow Clay Loam 10–14 P.Z. in the Caliente FO. Site ID 0329RD01.

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ATTACHMENT H-2

Caliente Field Office Maps

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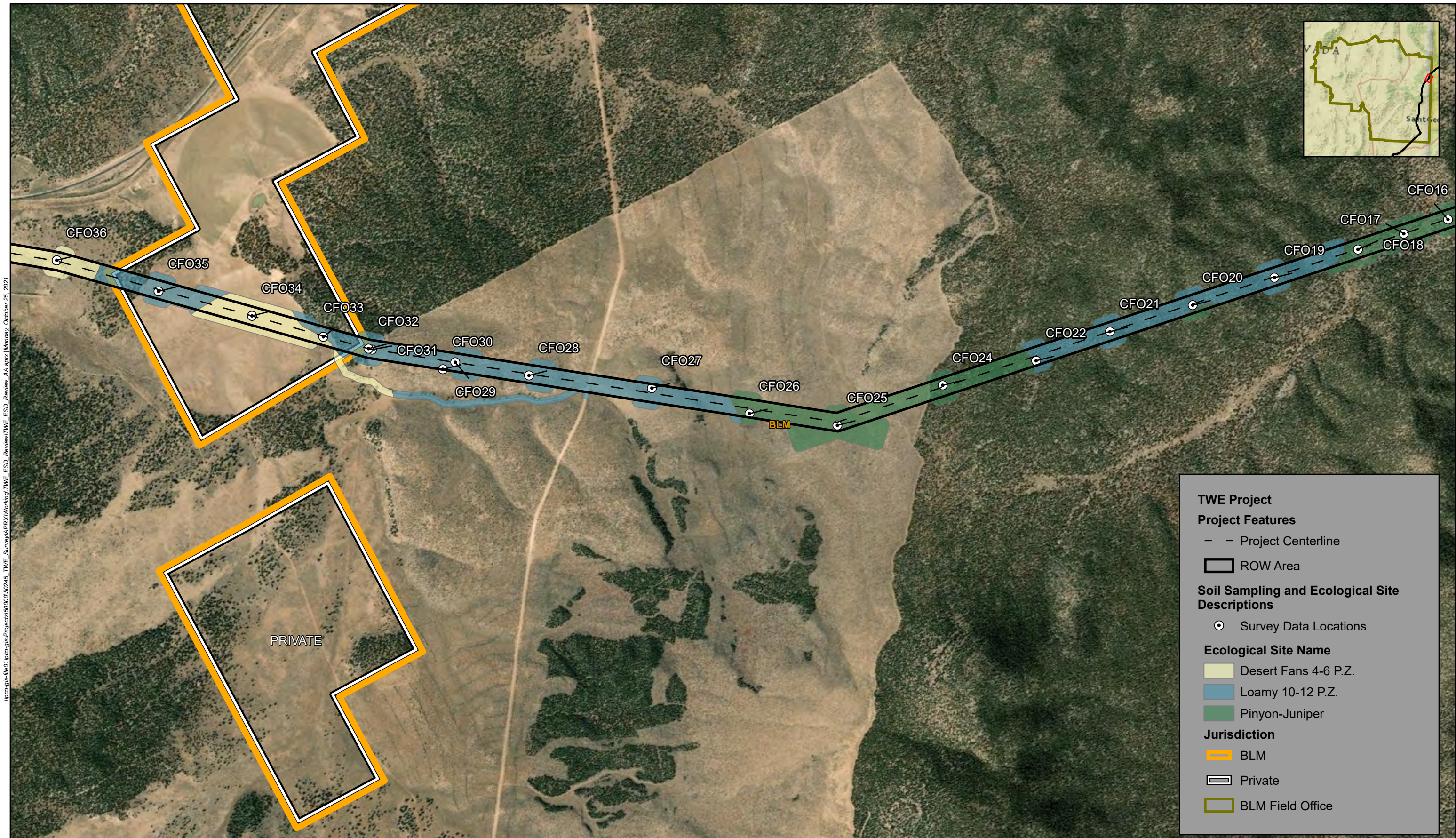
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Ecological Site Descriptions - Caliente Field Office
TransWest Express Transmission Project



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Source: BLM 2015

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Source: BLM 2015

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Ecological Site Descriptions - Caliente Field Office

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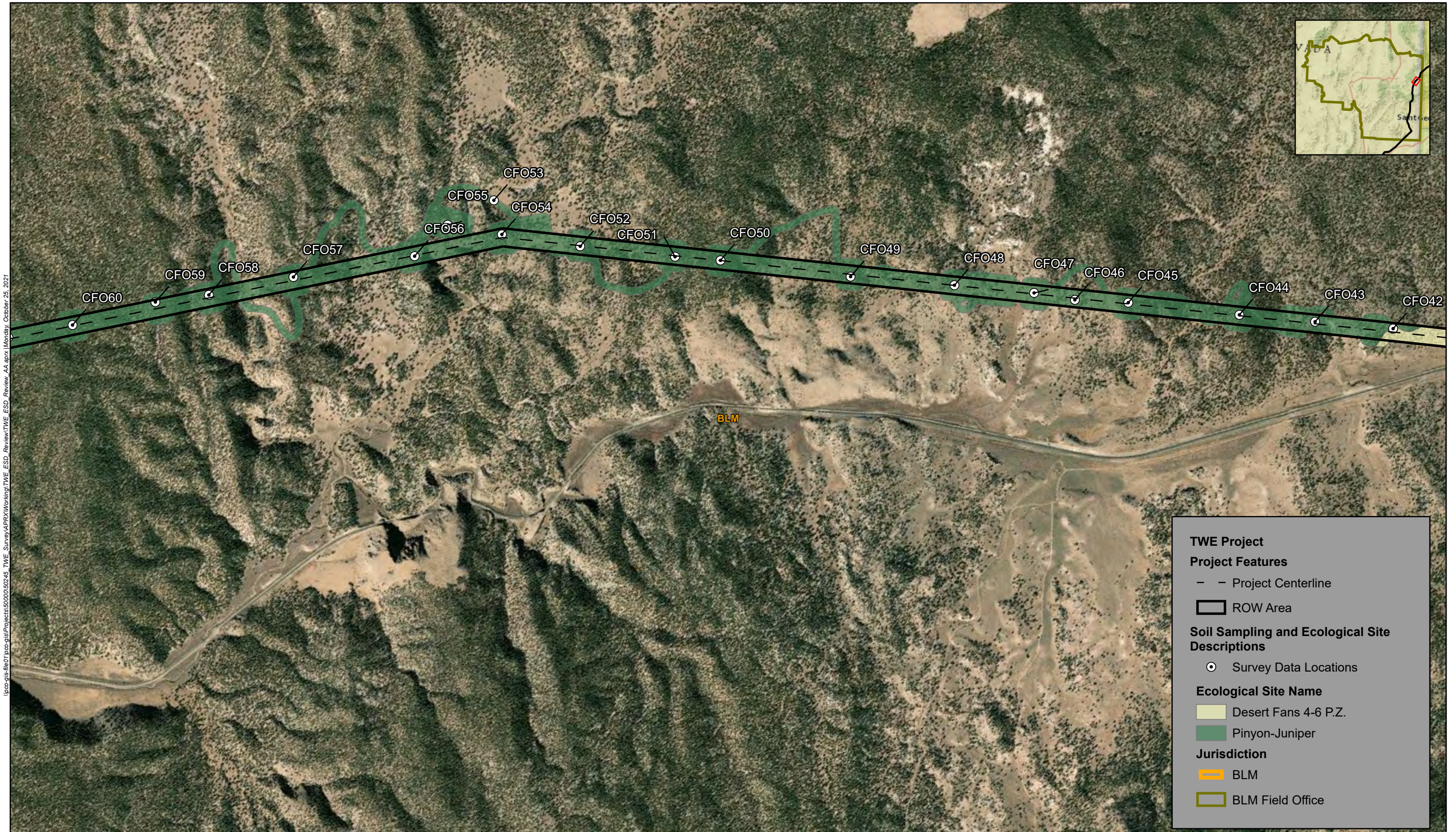
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Ecological Site Descriptions - Caliente Field Office
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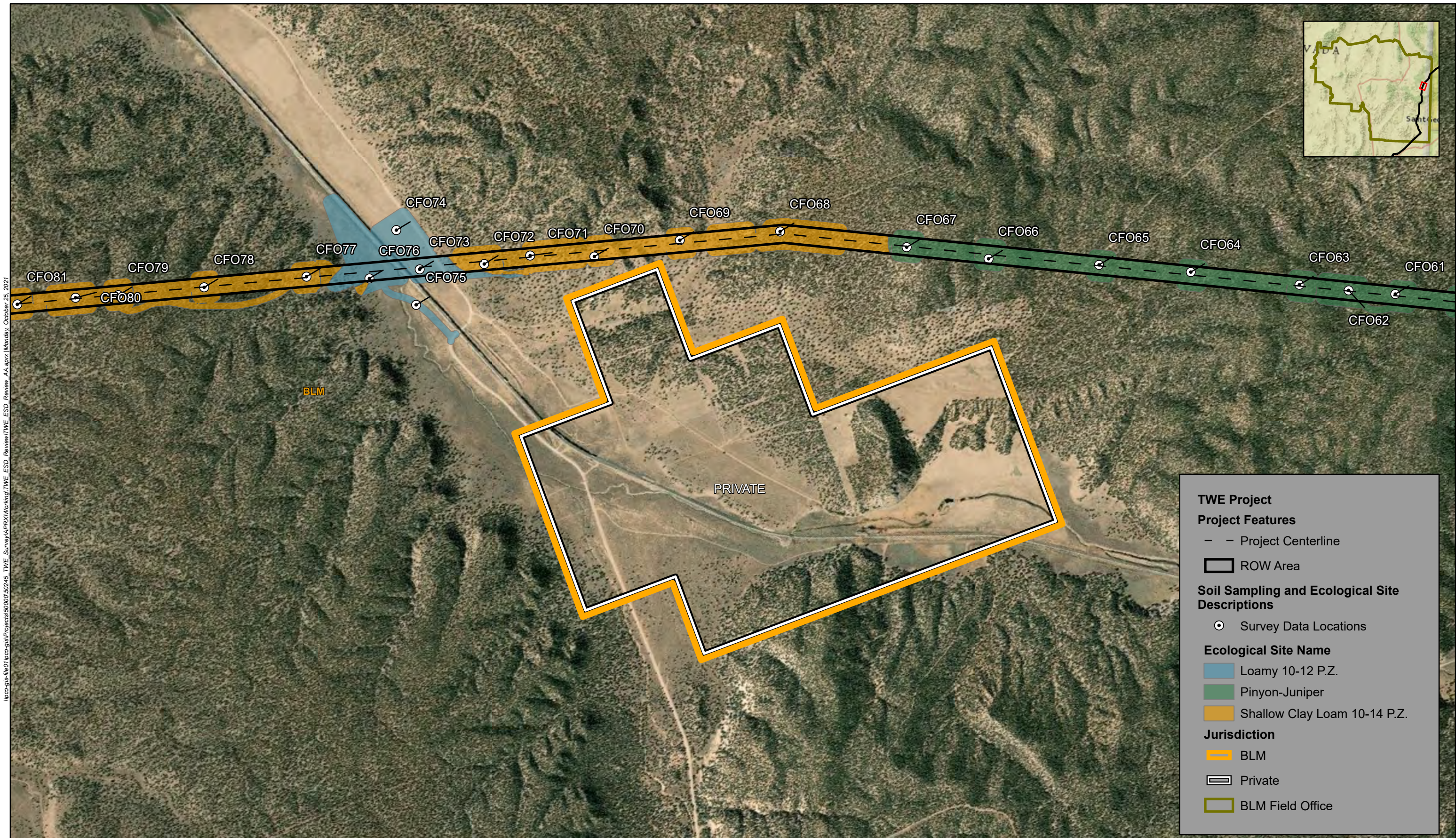
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Ecological Site Descriptions - Caliente Field Office

TransWest Express Transmission Project



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Source: BLM 2015

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Ecological Site Descriptions - Caliente Field Office

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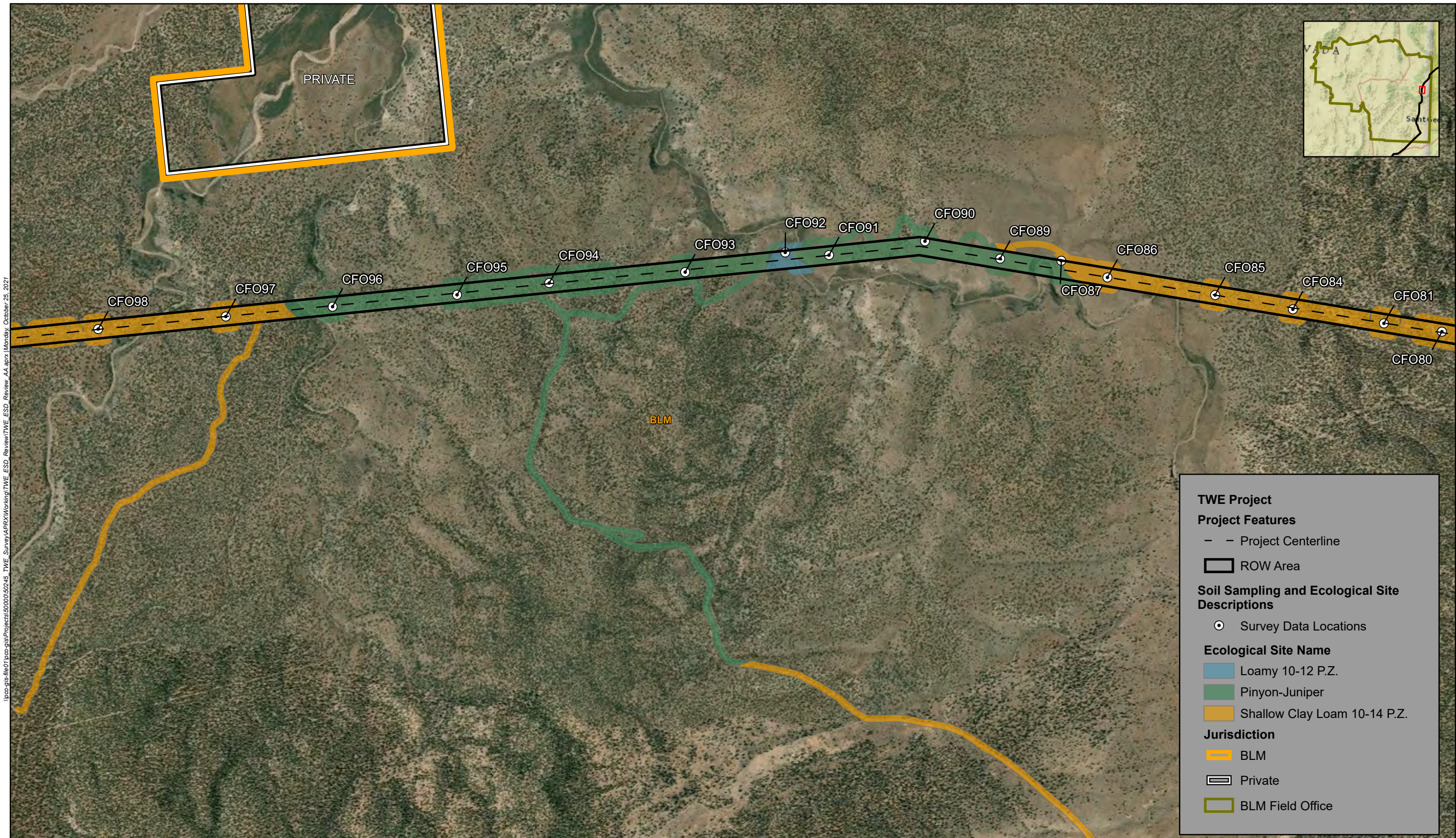
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Ecological Site Descriptions - Caliente Field Office

TransWest Express Transmission Project



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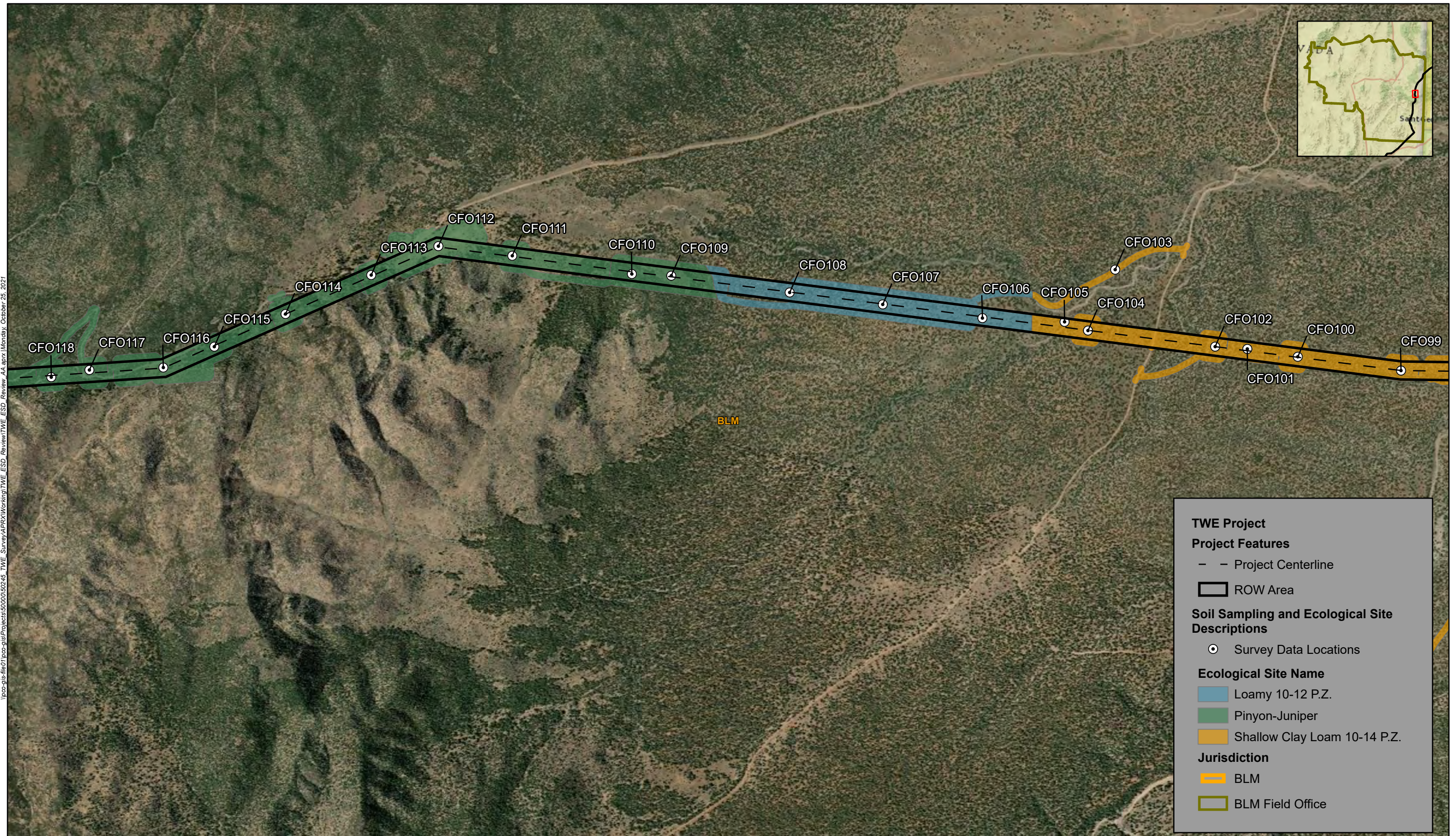
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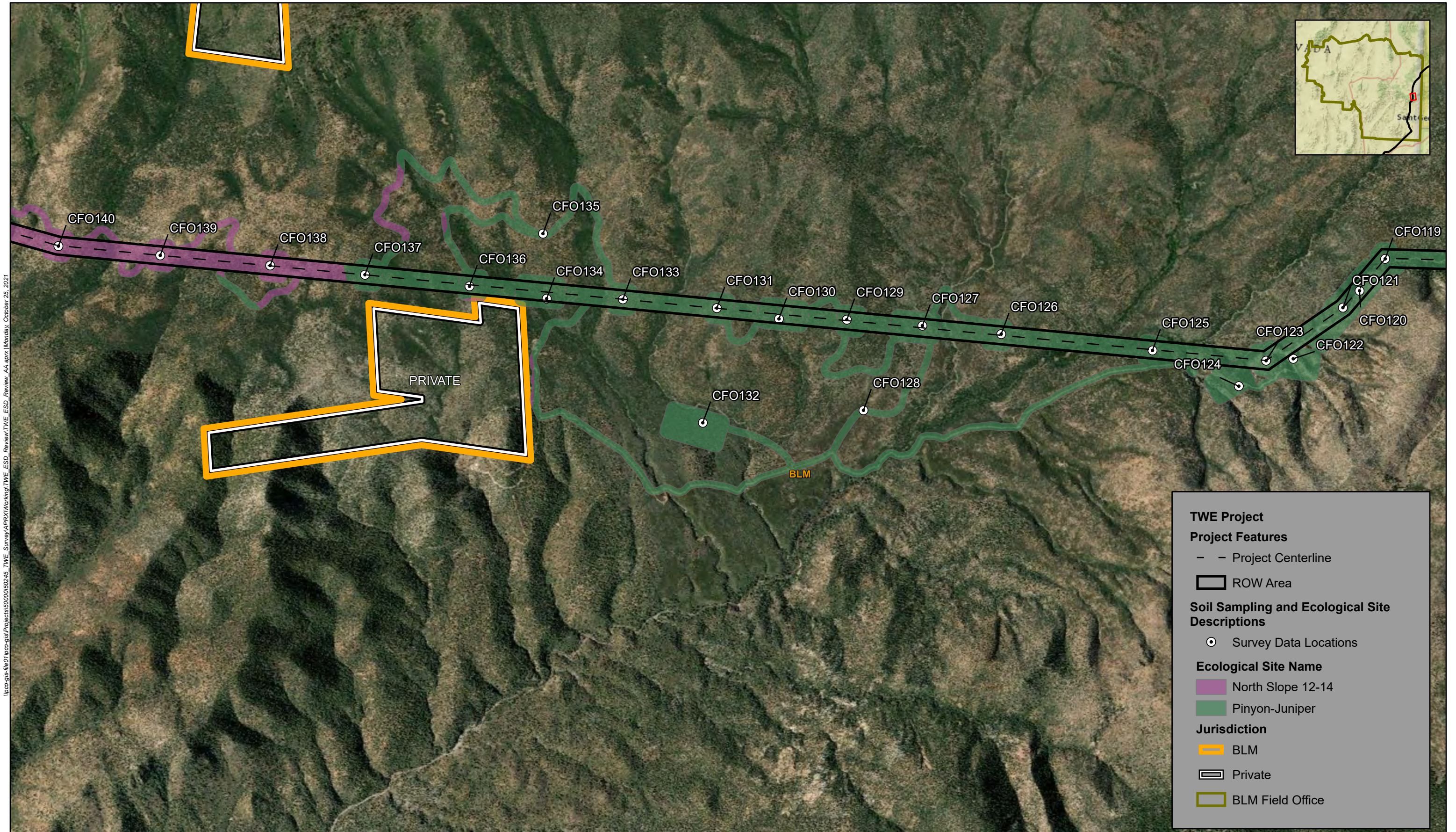
Ecological Site Descriptions - Caliente Field Office
TransWest Express Transmission Project



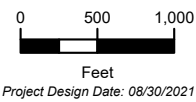
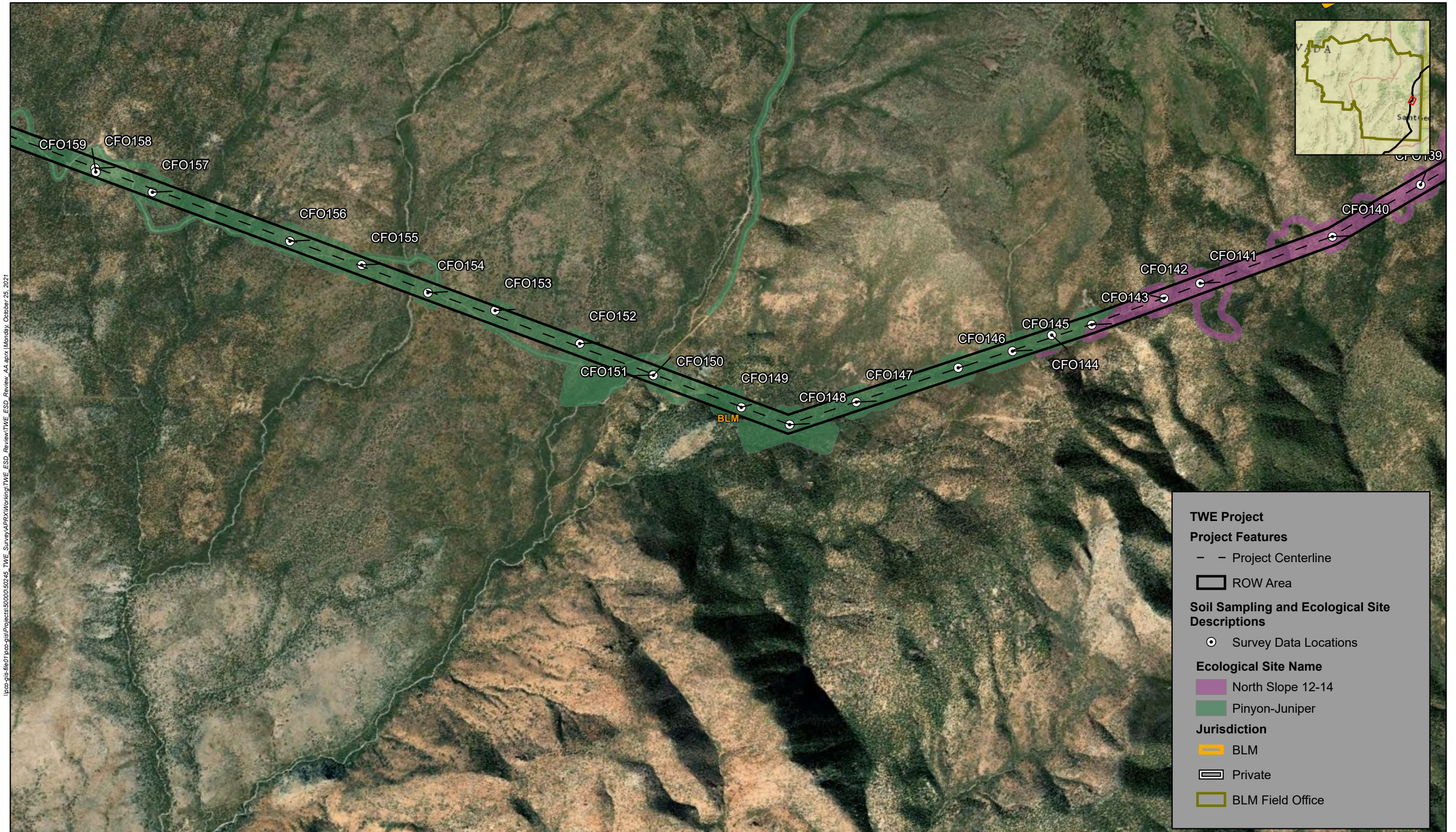
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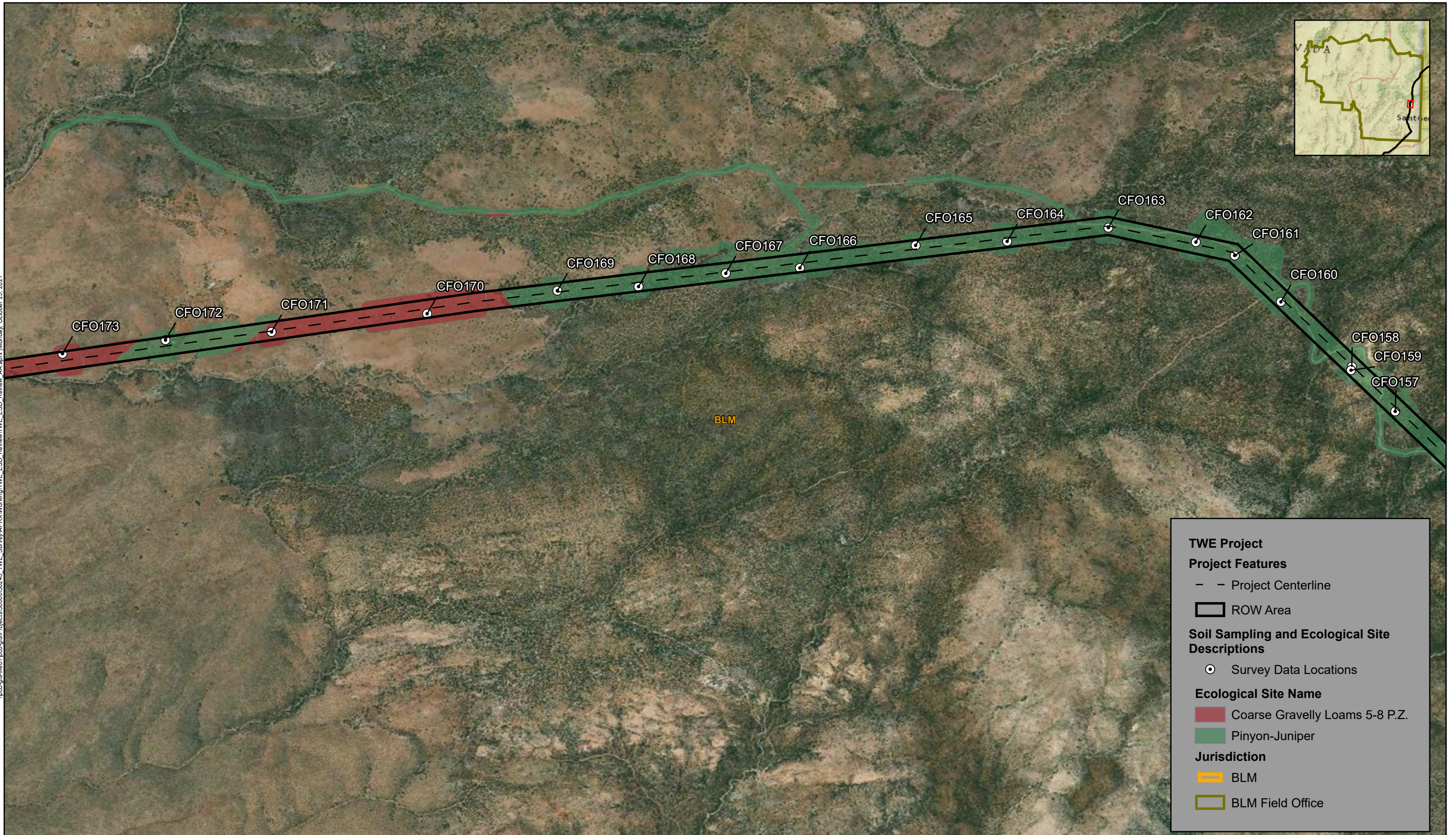
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Ecological Site Descriptions - Caliente Field Office

TransWest Express Transmission Project



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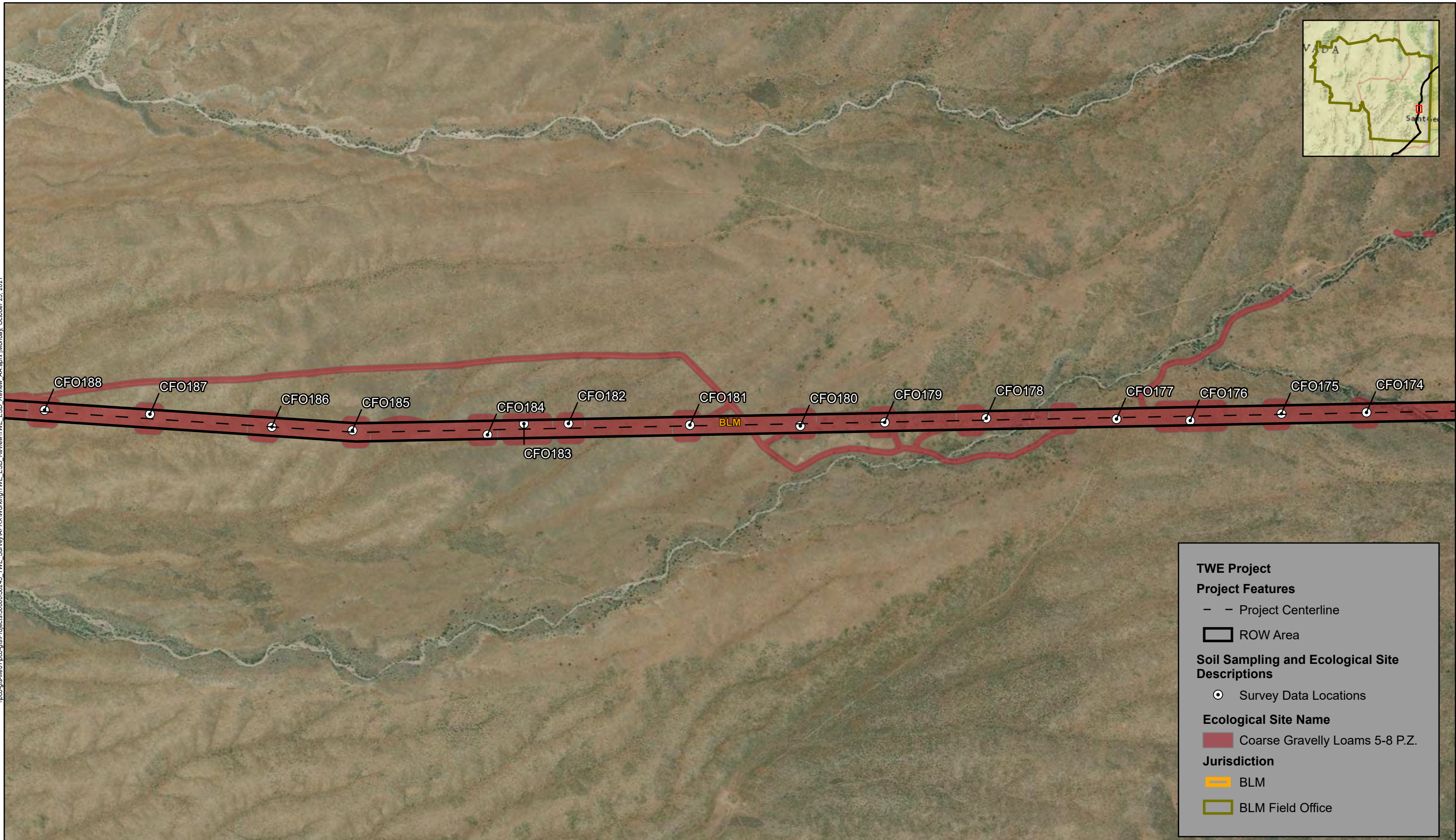
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Ecological Site Descriptions - Caliente Field Office

TransWest Express Transmission Project



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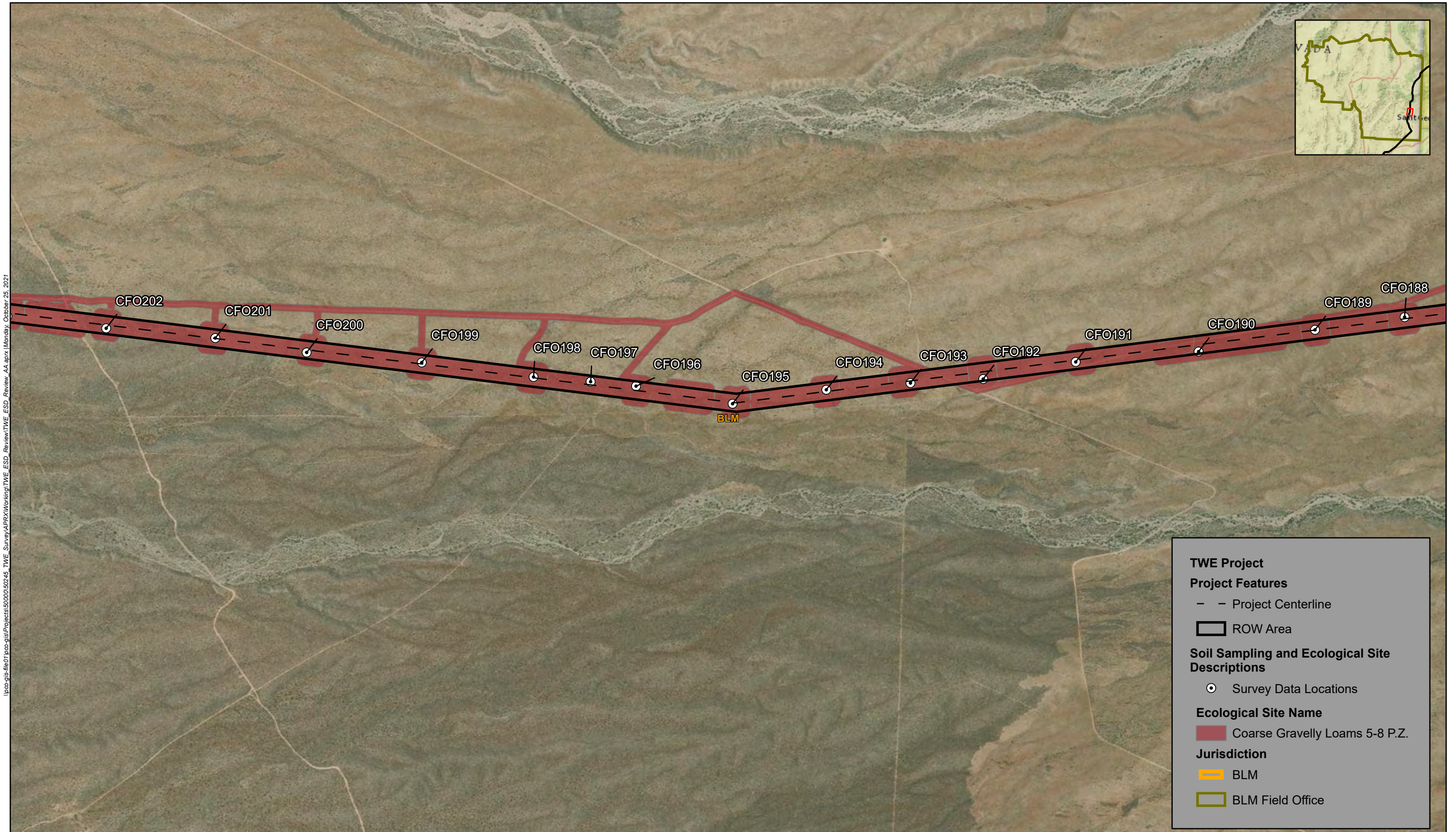
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Ecological Site Descriptions - Caliente Field Office
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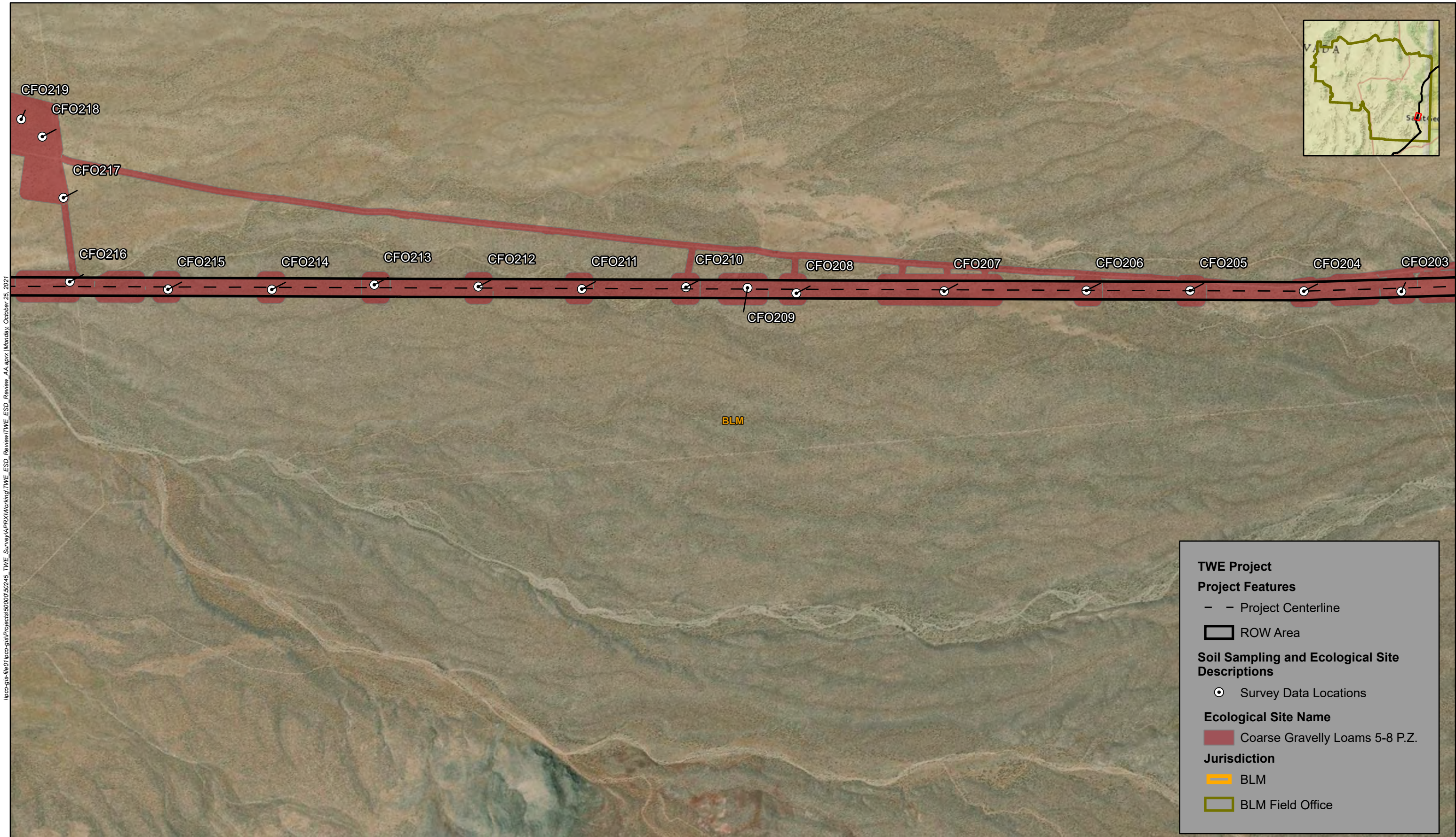
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Ecological Site Descriptions - Caliente Field Office

TransWest Express Transmission Project



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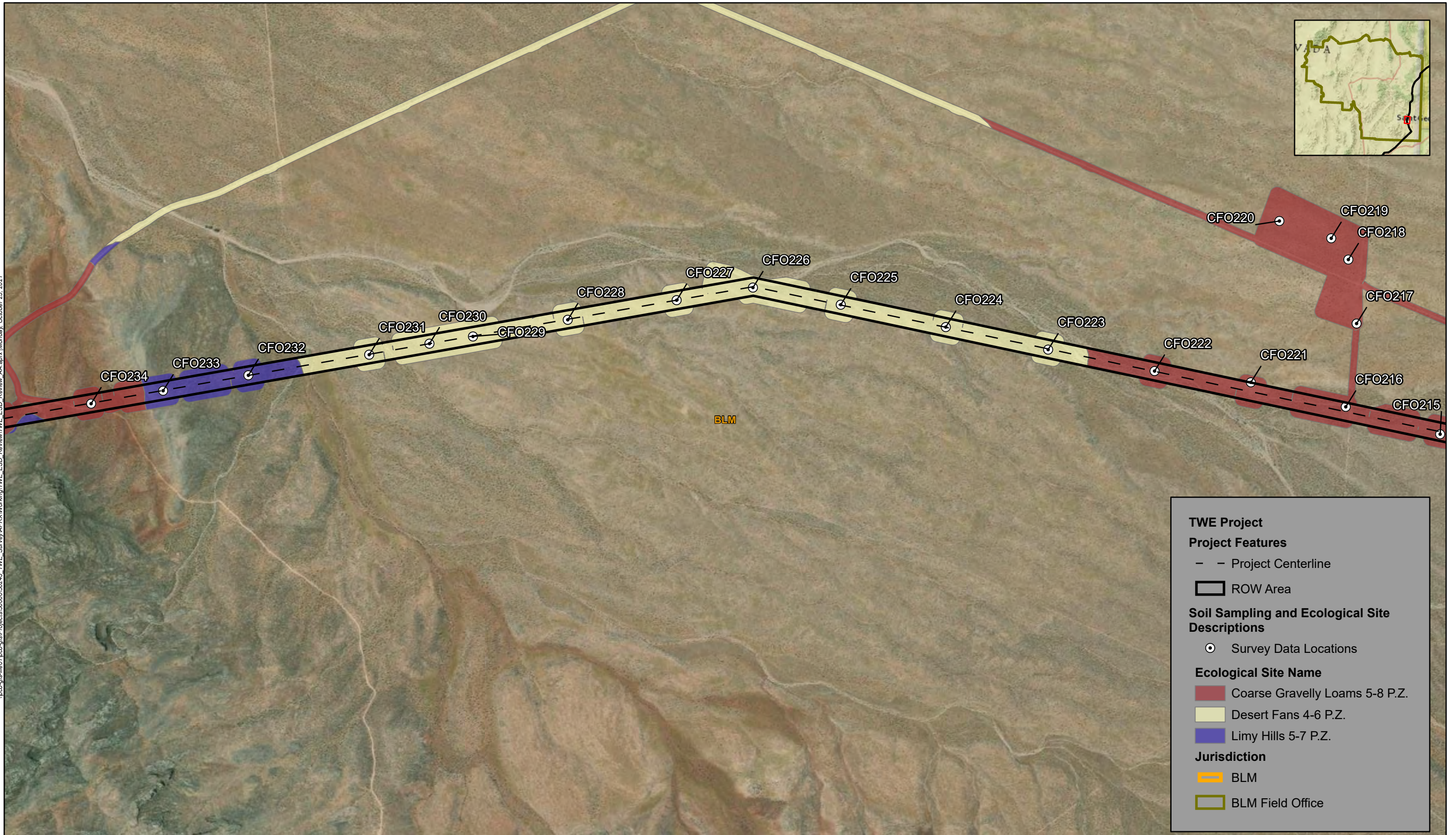
Project Design Date: 08/30/2021
Source: BLM 2015

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Ecological Site Descriptions - Caliente Field Office
TransWest Express Transmission Project



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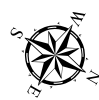
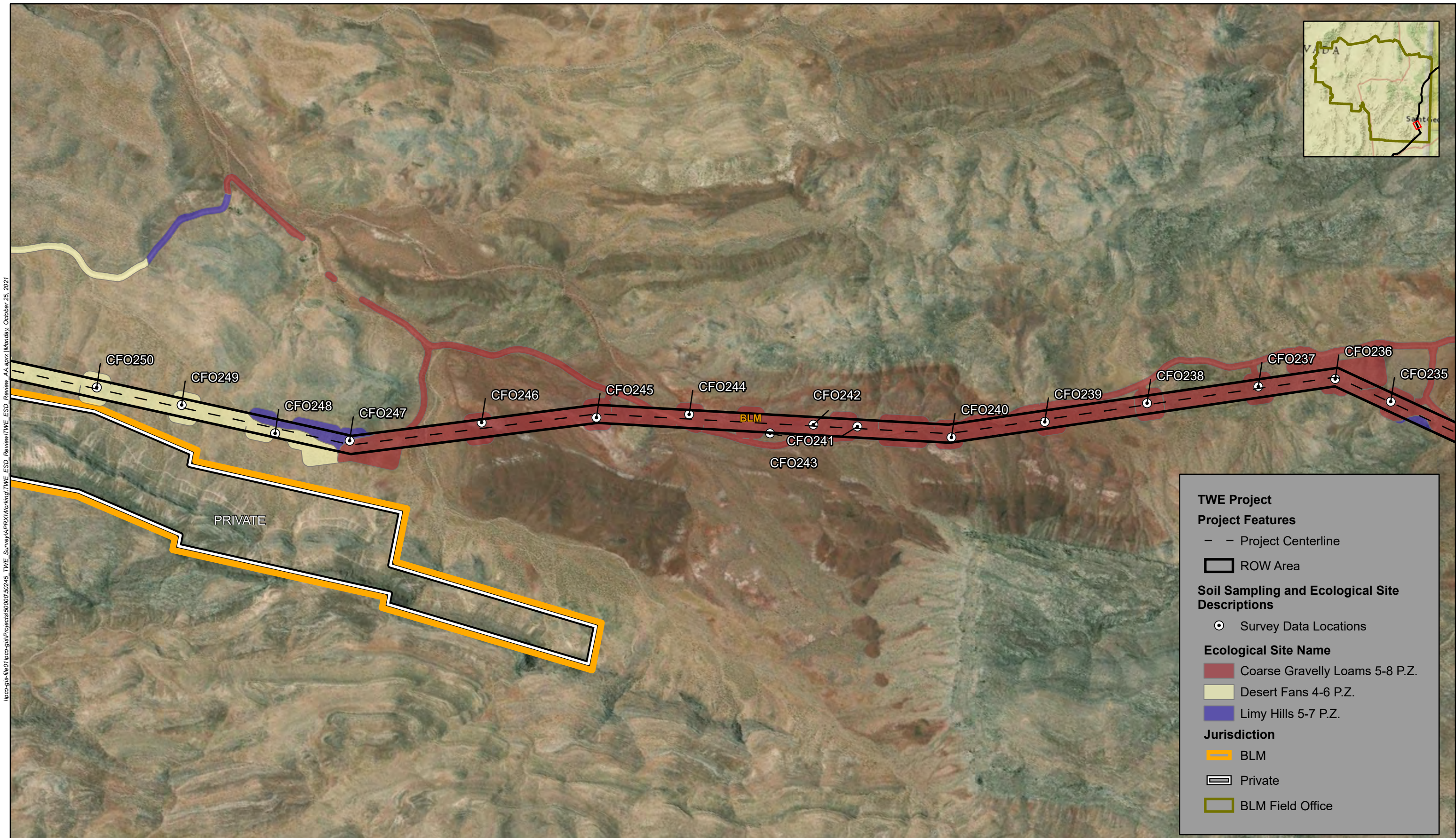
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Project Design Date: 08/30/2021
Source: BLM 2015

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Ecological Site Descriptions - Caliente Field Office
TransWest Express Transmission Project



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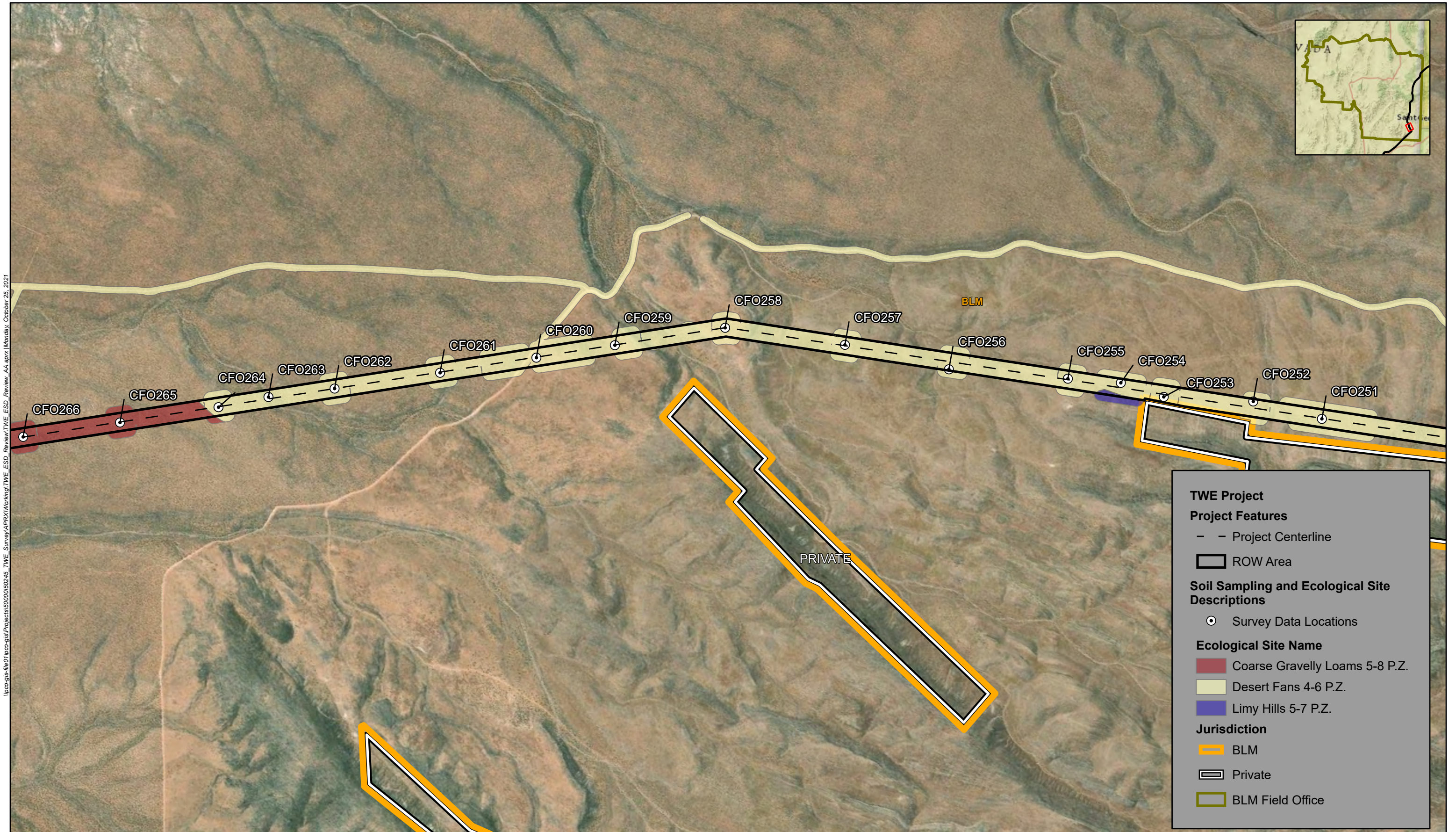
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Source: BLM 2015

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Ecological Site Descriptions - Caliente Field Office
TransWest Express Transmission Project



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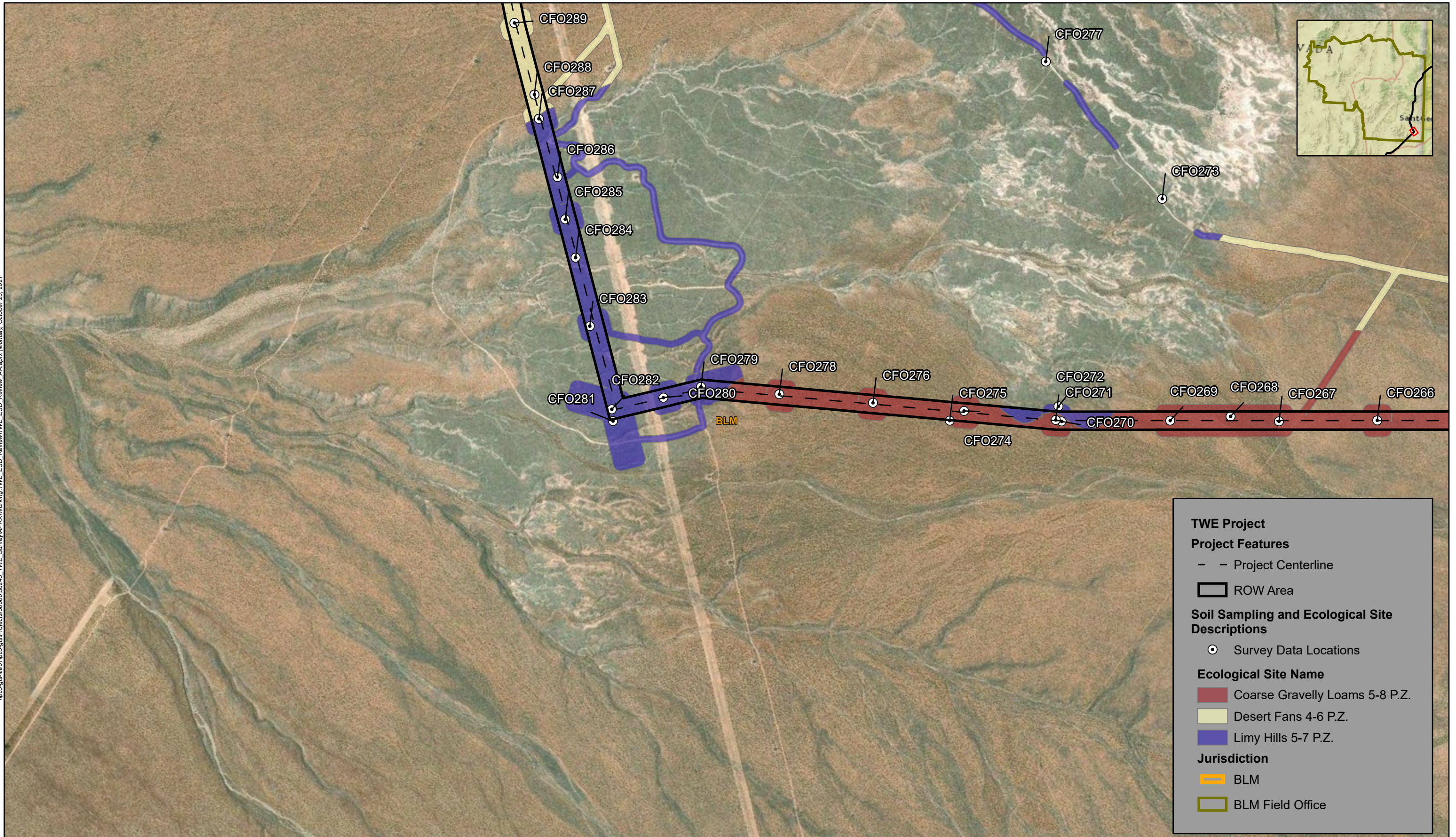
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Project Design Date: 08/30/2021
Source: BLM 2015

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Ecological Site Descriptions - Caliente Field Office
TransWest Express Transmission Project



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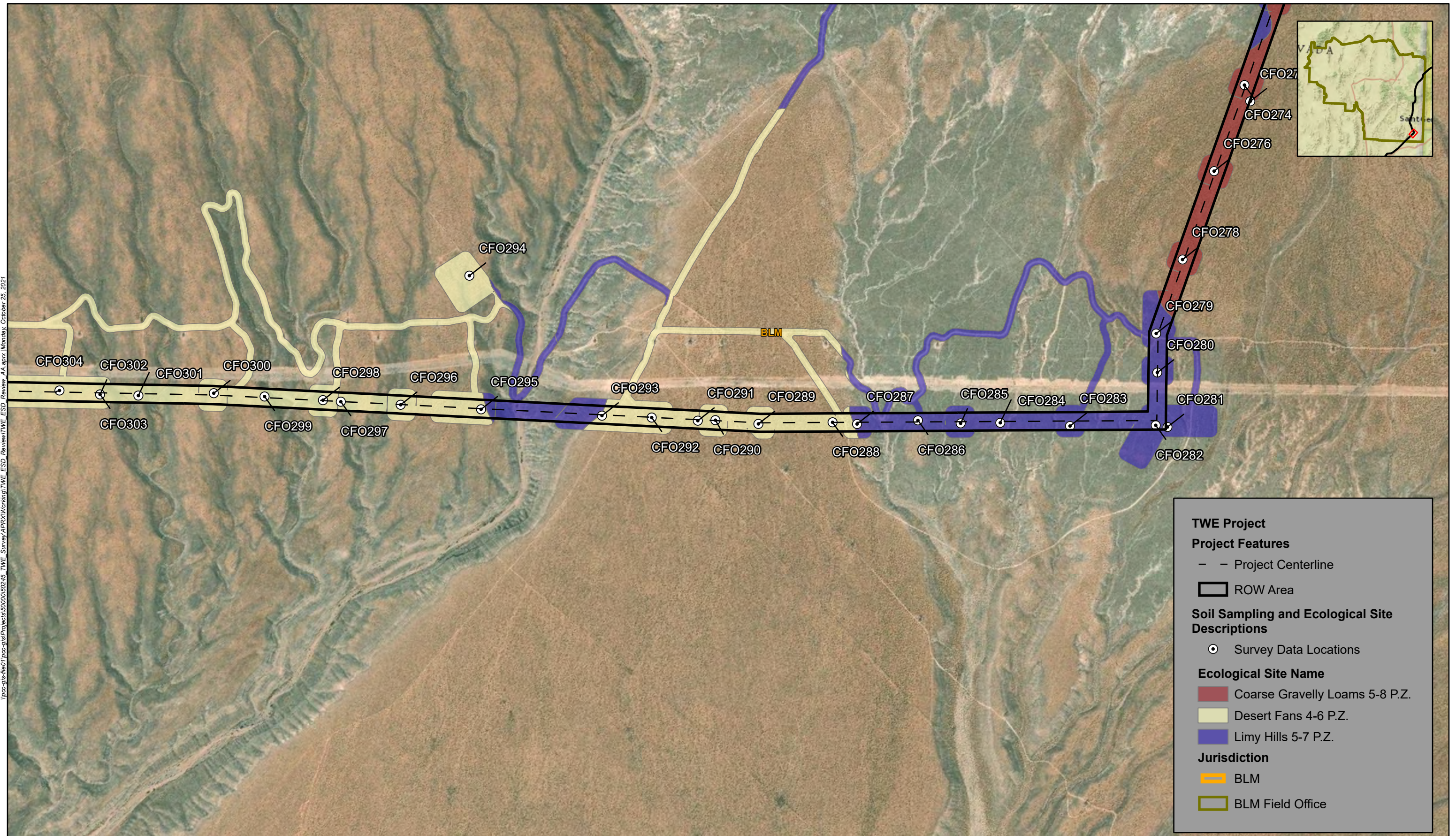
Map 19 of 23

Ecological Site Descriptions - Caliente Field Office

TransWest Express Transmission Project



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TWE Project

Project Features

- - Project Centerline
- ROW Area

Soil Sampling and Ecological Site Descriptions

- Survey Data Locations

Ecological Site Name

- Coarse Gravelly Loams 5-8 P.Z.
- Desert Fans 4-6 P.Z.
- Limy Hills 5-7 P.Z.

Jurisdiction

- BLM
- BLM Field Office



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Project Design Date: 08/30/2021
Source: BLM 2015



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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- ⊙ Survey Data Locations

Ecological Site Name

- ▭ Coarse Gravelly Loams 5-8 P.Z.
- ▭ Desert Fans 4-6 P.Z.

Jurisdiction

- ▭ BLM
- ▭ BLM Field Office



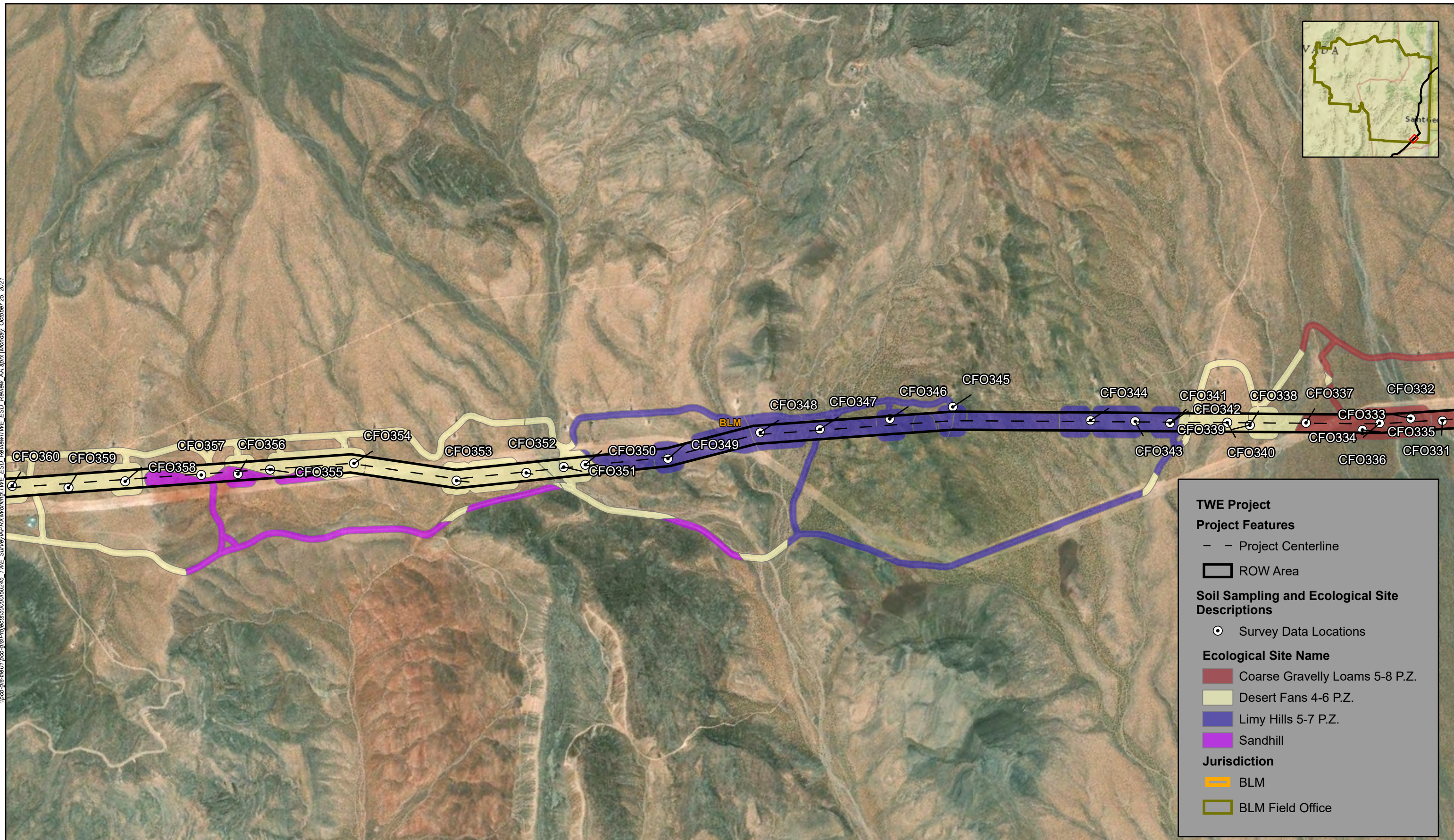
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Project Design Date: 08/30/2021
Source: BLM 2015



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Source: BLM 2015

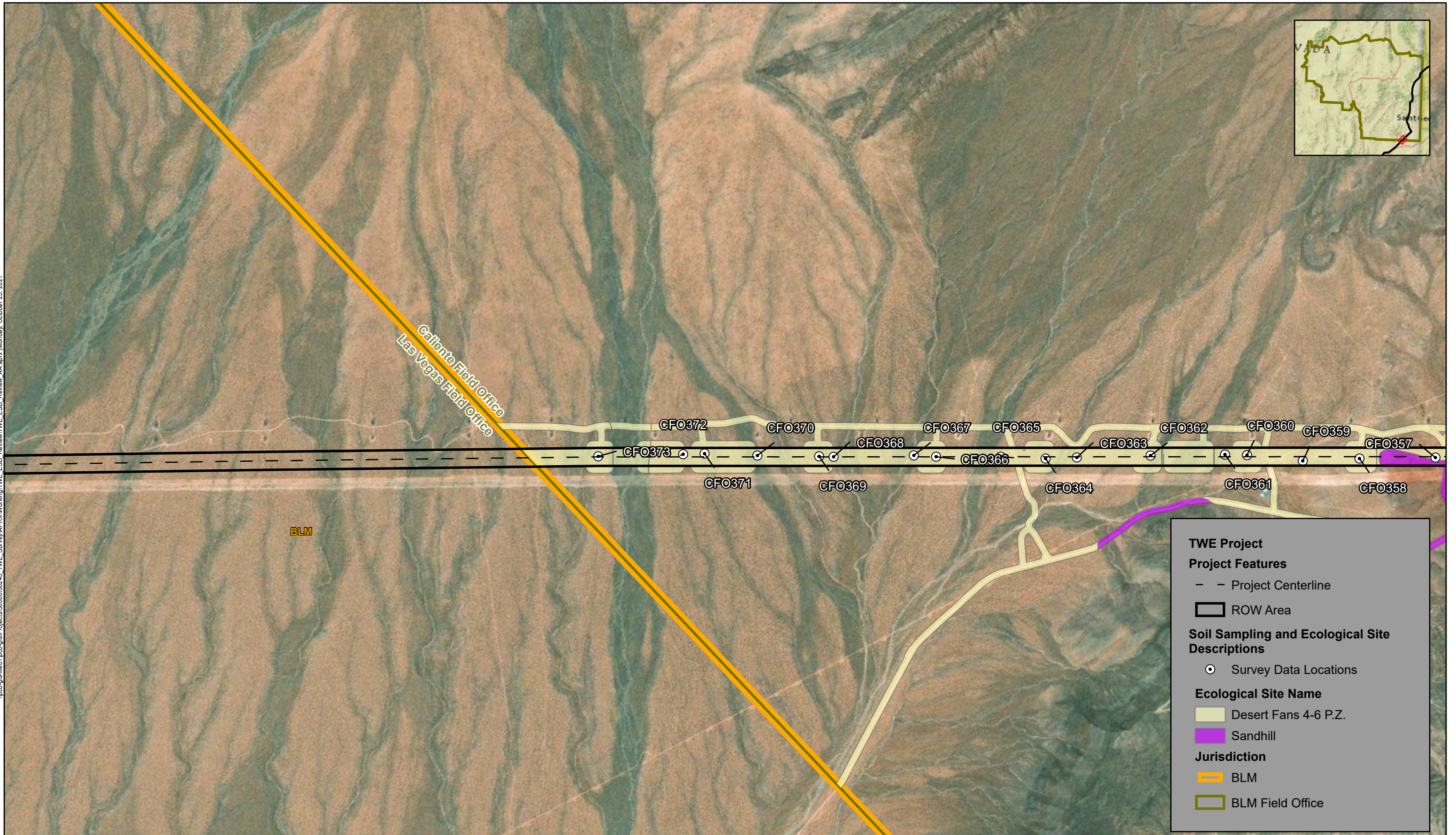
Map 22 of 23

Ecological Site Descriptions - Caliente Field Office

TransWest Express Transmission Project



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Project Design Date: 08/30/2021
Source: BLM 2015

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Ecological Site Descriptions - Caliente Field Office

TransWest Express Transmission Project



APPENDIX I

Las Vegas Field Office Ecological Site Descriptions

1.0 ENVIRONMENTAL SETTINGS

1.1 Mohave Basin and Range Major Land Resource Area

In Nevada, the TransWest Express Transmission Project (TWE Project) is in the Mojave Desert Major Land Resource Area (MLRA) (MLRA-30). Elevation ranges from 282 feet (85 meters) below sea level in Death Valley to 3,950 feet (1,205 meters) above sea level in valleys and basins. The lowest elevation occurring on dry land in the world, 282 feet (85 meters) below sea level, occurs in the Badwater Basin in Death Valley. Some mountain ranges have peaks that exceed 11,100 feet (3,385 meters). The average annual precipitation is 2 to 8 inches (50 to 205 millimeters) in most of this extremely dry MLRA. It exceeds 37 inches (940 millimeters) in some scattered areas at the higher elevations in Nevada and southwestern Utah. These storms occur more frequently in the eastern part of the area, where they contribute more to soil moisture. Snow is not very common and usually is on the ground for very short periods at the lower elevations, but the highest elevations may have snow for several weeks at a time in the winter. The average annual snowfall ranges from nearly 0 inches in the lowest deserts to more than 30 inches (760 millimeters) at the highest elevations of the Spring Mountains directly west of Las Vegas. The average annual temperature ranges from 43 degrees Fahrenheit (°F) (6 degrees Celsius) in the highest mountains to 76°F (25 degrees Celsius) in areas along the Colorado River in California, Nevada, and Arizona.

The dominant soil orders in this MLRA are Aridisols and Entisols. The soils in the area dominantly have a thermic soil temperature regime, an aridic soil moisture regime, and mixed or carbonatic mineralogy. They generally are well drained to excessively drained, loamy-skeletal or sandy-skeletal, and shallow to very deep. Torriorthents formed in alluvium on fan pediments, alluvial fans, fan aprons, and floodplains (Arizo, Carrizo, Hesperia, and Yermo series) and in residuum and colluvium on limestone and dolomite hills and mountains (St. Thomas series), on volcanic hills and mountains (Sunrock series), and on granite hills and mountains (Dalvord and Goldroad series). Torripsamments (Cajon series), Haplocalcids (Gunsight, Huevi, Tonopah, and Weiser series), and Petrocalcids (Bard, Cave, and Mormon Mesa series) formed in alluvium on alluvial fans, fan aprons, mesas, and terraces.

This area supports thin strands of desert vegetation. Creosote bush (*Larrea tridentata*), burrobush (*Ambrosia dumosa*), Joshua tree (*Yucca brevifolia*), juniper (*Juniperus* spp.), yucca (*Yucca* spp.), cactus, and mormon tea (*Ephedra nevadensis*) are the major species. Numerous annual forbs and grasses grow during years of favorable moisture. Fourwing saltbush (*Atriplex canescens*), saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), and iodinebush (*Allenrolfea occidentalis*) grow on alkali flats. Indian ricegrass (*Achnatherum hymenoides*), Joshua tree, desert needlegrass (*Stipa speciose*), and galleta (*Pleuraphis* spp.) grow on sandy soils.

1.2 Ecological Site Distribution

Dominant ecological sites in the TWE Project right-of-way within the Las Vegas Field Office (FO) include Desert Fans 4–6 P.Z. (1,295.8 acres) and Limy Hills 3–5 P.Z. (349.8 acres). Less prevalent ecological sites include Saline Bottom (8.6 acres) and Loamy Bottom (10.6 acres). All ecological sites are located within BLM managed lands (Table I-1). A photograph of each ecological site is provided in Attachment I-1. Maps depicting the ecological site locations in the TWE Project right-of-way are provided in Attachment I-2.

TABLE I-1 ECOLOGICAL SITE DISTRIBUTION IN THE BLM LAS VEGAS FO

Ecological Site*	Managing Agency	Right-of-Way Area (acres)	Permanent Disturbance Area (acres)	Temporary Work Area (acres)
Bottomlands		204	2	106
Loamy Bottom	BLM	3	<1	7
Saline Bottom	BLM	0	<1	0
Valley Wash	BLM	201	2	99
Desert Fans		1,061	64	647
Desert Fans 4–6 P.Z.	BLM	1,061	64	647
Limy Hills		345	7	220
Limy Hills 3–5 P.Z.	BLM	345	7	220
Steep Stony Slopes		132	1	77
Steep Stony Slopes	BLM	132	1	77
Other†		1	<1	3

* P.Z. = Precipitation zone (inches).

† Other ecological sites include human modified sites (i.e., 'Disturbed and Developed' site).

1.3 Rangeland Analysis Platform

RAP was used to further assess the distribution and estimated cover of vegetation and cover types across the Project (NRCS and BLM 2021). RAP integrates data from NRCS's National Resources Inventory and BLM's Assessment, Inventory, and Monitoring and Landscape Monitoring Framework datasets. These quantitative vegetative assessments are modeled with historical Landsat satellite records, gridded meteorology data, and abiotic land surface data to provide estimates of the percent vegetation cover of different growth forms. RAP data were used to define the vegetation and abiotic characteristics for the Project and to develop reclamation success cover standards for each ecological site and DRG, as defined in Table I-2.

TABLE I-2 DRG RAP ATTRIBUTE DATA FOR THE BLM CEDAR CITY FO

DRG	ESD	Forbs and Grasses - Annuals (%)	Forbs and Grasses - Perennial (%)	Woody (%)	Litter (%)	Bareground (%)
Bottomlands	Loamy Bottom	17.9	5.9	9.3	12.1	39.3
	Saline Bottom	9.1	5.0	14.9	9.6	28.7
	Valley Wash	5.5	2.5	9.6	6.2	37.2
	SUBTOTAL	10.8	4.5	11.3	9.3	35.1
Desert Fans	Desert Fans	9.2	3.1	10.0	8.0	36.1
	SUBTOTAL	9.2	3.1	10.0	8.0	36.1
Limy Hills	Limy Hills	8.5	2.9	9.8	7.7	40.9
	SUBTOTAL	8.5	2.9	9.8	7.7	40.9
Stony Slopes	Steep Stony Slopes	8.4	4.2	11.9	7.3	19.6
	SUBTOTAL	8.4	4.2	11.9	7.3	19.6

Source: NRCS and BLM 2021

2.0 INDIVIDUAL ECOLOGICAL SITE DESCRIPTIONS

2.1 Saline Bottom Ecological Site Description

Saline Bottom ecological sites in the TWE Project within the Las Vegas FO occur on fan remnants and alluvial fans on all exposures. Slopes range from 0% to 15%, but slope gradients of 2% to 8% are typical (NRCS 2020a). Major soil series associated with Saline Bottom ecological sites include Haleburu, Crosgrain, Huevi, Hiller, St Thomas, and Iceberg. The climate in Limy Hills 3–5 P.Z. ecological sites is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. The climate is arid and is characterized by cool, moist winters and hot, dry summers. The relative humidity is low, evaporation is high, the percentage of sunshine is high, and the daily and seasonal range in temperature is wide. The average annual precipitation ranges from 3 to 5 inches.

2.1.1 Soil Characteristics

Saline Bottom ecological sites are characterized as deep to very deep and soils are typically poorly drained (Table I-3; NRCS 2020a). Average topsoil depth is approximately 2.8 ± 2.2 inches. These soils are normally strongly salt- and sodium-affected in their upper profile with soil reaction and salt and sodium usually decreasing with depth. Soil pH (pH > 8.4), salinity (EC > 4.0 dS/m), and sodicity (SAR > 12.0) may limit vegetation growth in some areas (see Table I-3).

TABLE I-3 SOIL CHARACTERISTICS TYPICAL OF SALINE BOTTOM ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in mixed alluvium
Topsoil depth	2.8 ± 2.2 inches
Topsoil texture	Loamy and clay loam
Topsoil fragments	–
Topsoil pH	7.9–9.0
Topsoil salinity (EC)	–
Topsoil sodicity (SAR)	–
Subsoil texture	Loamy
Subsoil fragments	–
Subsoil pH	7.9–9.0
Subsoil salinity (EC)	–
Subsoil sodicity (SAR)	–

Sources: NRCS (2020a, 2020d)

2.1.2 Vegetation

Vegetative composition by growth forms in Saline Bottom ecological sites is approximately 20% shrubs, 75% grasses and grass-like plants, and 5% forbs (Table I-4; NRCS 2020a). The dominant grasses that may occur in Saline Bottom ecological sites include alkali sacaton, basin wildrye (*Leymus cinereus*), and saltgrass. Secondary grasses and grass-like plants include western wheatgrass (*Pascopyrum smithii*), common reed (*Phragmites australis*), and alkaligrass (*Puccinellia*). Dominant woody plants found at this site include greasewood (*Sarcobatus vermiculatus*), whiteflower rabbitbrush (*Chrysothamnus albidus*), rubber rabbitbrush (*Ericameria nauseosa*), and western wheatgrass. Secondary woody species include Sandberg bluegrass (*Poa secunda*), alkaligrass (*Puccinellia*), iodinebush, shadscale saltbush, Parry's

saltbush (*Atriplex parryi*), Torrey's saltbush (*Atriplex torreyi*), and seepweed (*Suaeda* spp.) (NRCS 2020a).

TABLE I-4 VEGETATION CHARACTERISTICS TYPICAL OF SALINE BOTTOM ECOLOGICAL SITES

Growth Form	Composition
Grasses	75%
Forbs	5%
Shrubs	20%

Source: NRCS (2020a)

2.2 Loamy Bottom Ecological Site Description

Loamy Bottom ecological sites in the TWE Project within the Las Vegas FO occur on stream terraces, drainage ways, floodplains, and alluvial fans. Slopes are typically 0% to 5% and this site often receives extra water from surrounding uplands (NRCS 2020a). Major soil series associated with Loamy Bottom ecological sites include Toquop and Virgin River soil series. The climate in Loamy Bottoms ecological sites is characterized by warm, dry summers and cold, wet winters and springs. The average annual precipitation ranges from 5 to 15 inches.

2.2.1 Soil Characteristics

Loamy Bottom ecological sites are characterized as deep, permeability is slow to moderate, and soils are well drained (Table I-5; NRCS 2020a). Topsoil textures include silt loam, loam, and silty clay loam. Average topsoil depth is approximately 7.5 ± 1.5 inches. Subsoil textures are characterized as loamy. Subsoil texture is loamy. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table I-5).

TABLE I-5 SOIL CHARACTERISTICS TYPICAL OF LOAMY BOTTOM ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in alluvium derived from sandstone, limestone, or quartzite
Topsoil depth	7.5 ± 1.5 inches
Topsoil texture	Silt loam, loam, and silty clay loam
Topsoil fragments	0%–8%
Topsoil pH	7.4–9.0
Topsoil salinity (EC)	0–4 dS/m
Topsoil sodicity (SAR)	0
Subsoil texture	Loamy
Subsoil fragments	0%–12%
Subsoil pH	7.4–9.0
Subsoil salinity (EC)	0–4 dS/m
Subsoil sodicity (SAR)	0

Sources: NRCS (2020a, 2020d)

2.2.2 Vegetation

Vegetative composition by growth forms in Loamy Bottoms ecological sites is approximately 20% shrubs, 70% grasses and grass-like plants, and 10% forbs (Table I-6; NRCS 2020a). The dominant grasses that may occur in Steep Stony Loams ecological sites are basin wildrye and western wheatgrass. Subdominant grasses and grass-like plants include Indian ricegrass, squirreltail (*Elymus elymoides*), needle and thread (*Hesperostipa comata*), and alkali sacaton. Dominant woody plants found at this site include basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and rubber rabbitbrush. Secondary woody species include fourwing saltbush, yellow rabbitbrush (*Chrysothamnus viscidiflorus*), Nevada jointfir, Woods' rose (*Rosa woodsii*), greasewood, and spineless horsebrush (*Tetradymia canescens*) (NRCS 2020a).

TABLE I-6 VEGETATION CHARACTERISTICS TYPICAL OF LOAMY BOTTOM ECOLOGICAL SITES

Growth Form	Composition
Grasses	70%
Forbs	10%
Shrubs	20%

Source: NRCS (2020a)

2.3 Valley Wash Ecological Site Description

Valley Wash ecological sites in the TWE Project within the Las Vegas FO occur in drainageways of inset fans and axial-stream terraces. Slopes range from 0% to 15%, but slope gradients of 2% to 8% are typical (NRCS 2020a). Major soil series associated with Valley Wash ecological sites include Arizo, Gypwash, Callville, Carrizo, Redneedle, Heleweiser, Tonopah, and Upperline. The climate in Valley Wash ecological sites is characterized by cool, moist winters and hot, dry summers. The average annual precipitation ranges from 5 to 8 inches.

2.3.1 Soil Characteristics

Valley Wash ecological sites are characterized as deep, runoff is medium, and soils are well drained (Table I-7; NRCS 2020a). Topsoil textures include very gravelly sand, gravelly sandy, and very gravelly sandy loam. Average topsoil depth is approximately 2.2 ± 0.2 inches. Subsoil textures are characterized as loamy. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table I-7).

TABLE I-7 SOIL CHARACTERISTICS TYPICAL OF DESERT VALLEY WASH ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed from mixed sources
Topsoil depth	2.2 ± 0.2 inches
Topsoil texture	Very gravelly sand, gravelly sandy, and very gravelly sandy loam
Topsoil fragments	10%–50% gravel and cobbles
Topsoil pH	7.5–8.4
Topsoil salinity (EC)	–
Topsoil sodicity (SAR)	–
Subsoil texture	Loamy

Soil Characteristics	Description
Subsoil fragments	10%–40% gravel and cobbles
Subsoil pH	7.5–8.6
Subsoil salinity (EC)	–
Subsoil sodicity (SAR)	–

Sources: NRCS (2020a, 2020d)

2.3.2 Vegetation

Vegetative composition by growth forms in Valley Wash ecological sites is approximately 80% shrubs, 5% grasses and grass-like plants, and 15% forbs (Table I-8; NRCS 2020a). The dominant grasses that may occur in Valley Wash ecological sites are Indian ricegrass, threeawn, squirreltail, needle and thread, and sand dropseed (*Sporobolus cryptandrus*). Dominant woody plants found at this site include fourwing saltbush, woolly fruit bur ragweed (*Ambrosia eriocentra*), yellow rabbitbrush, Nevada jointfir, and purple sage (*Salvia dorrii* ssp. *dorrii* var. *incana*). Secondary woody species include yellow rabbitbrush, brittlebush, rubber rabbitbrush, broom snakeweed (*Gutierrezia sarothrae*), burrobrush, water jacket, and banana yucca (*Yucca baccata*) (NRCS 2020a).

TABLE I-8 VEGETATION CHARACTERISTICS TYPICAL OF DESERT VALLEY WASH ECOLOGICAL SITES

Growth Form	Composition
Grasses	5%
Forbs	15%
Shrubs	80%

Source: NRCS (2020a)

2.4 Desert Fans 4–6 P.Z. Ecological Site Description

Desert Fans 4–6 P.Z. ecological sites in the TWE Project within the Las Vegas FO occur extensively in the Mojave Desert and typically occur on fan piedmonts, broad alluvial fans, and fan remnants on all exposures. Slopes in this site range from 2% to 30%, but slope gradients of 2% to 15% are typical (Natural Resources Conservation Service [NRCS] 2011). Major soil series associated with Desert Fans 4–6 P.Z. ecological sites include Underton, Baseline, Gaurdian, Arada, Bluepoint, Tipnat, Akela, Haleburu, and Stand Grapevine. The climate in Desert Fans 4–6 P.Z. ecological sites is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. The climate is arid and is characterized by cool, moist winters and hot, dry summers. The relative humidity is low, evaporation is high, the percentage of sunshine is high, and the daily and seasonal range in temperature is wide. The average annual precipitation ranges from 5 to 8 inches.

2.4.1 Soil characteristics

Desert Fans 4–6 P.Z. ecological sites are characterized as shallow to moderately deep, runoff is typically low to medium, permeability is moderate to moderately rapid, and soils are typically well drained to excessively drained (Table I-9; NRCS 2020a). Topsoil textures include very gravelly fine sandy loam, very gravelly loamy sand, and very gravelly loam. Average topsoil depth is approximately 2.7 ± 1.7 inches. Soil depth to a layer restrictive to root development, such as a petrocalcic horizon, is greater than 10 inches. Subsoil textures are characterized by loam to silty clay loam (NRCS 2020a). Soil pH (pH > 8.4), salinity (electrical conductivity [EC] > 4.0 deciSiemens per meter [dS/m]), and sodicity (sodium adsorption ratio [SAR] > 12.0) may limit vegetation growth in some areas (see Table I-9).

TABLE I-9 SOIL CHARACTERISTICS TYPICAL OF DESERT FANS 4–6 INCH ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in mixed alluvium
Topsoil depth	2.7 ± 1.7 inches
Topsoil texture	Very gravelly fine sandy loam, very gravelly loamy sand, and very gravelly loam
Topsoil fragments	5%–90%
Topsoil pH	7.9–9.0
Topsoil salinity (EC)	0–8 dS/m
Topsoil sodicity (SAR)	0–30
Subsoil texture	Sandy loam to loam
Subsoil fragments	4%–69%
Subsoil pH	7.9–9.0
Subsoil salinity (EC)	0–8 dS/m
Subsoil sodicity (SAR)	0–30

Source: NRCS (2020a, 2020d)

2.4.2 Vegetation

Vegetative composition by growth forms in Desert Fans 4–6 P.Z. ecological sites is approximately 80% shrubs, 10% grasses and grass-like plants, and 10% forbs (Table I-10; NRCS 2020a). The dominant grasses that may occur in Desert Fans ecological sites include big galleta (*Pleuraphis rigida*) (NRCS 2020a). Secondary grasses that may occur include Indian ricegrass, desert needlegrass (*Achnatherum speciosum*), threeawn (*Aristida*), and sixweeks grama (*Bouteloua barbata*). Dominant woody plants found at this site include burrobush, creosote bush, littleleaf ratany (*Krameria erecta*), and Nevada jointfir (*Ephedra nevadensis*). Secondary woody species include shadscale saltbush (*Atriplex confertifolia*), brittlebush (*Encelia farinosa*), winterfat (*Krascheninnikovia lanata*), desert-thorn (*Lycium*), Fremont's dalea (*Psoralea fremontii*), and Mojave yucca (*Yucca schidigera*).

TABLE I-10 VEGETATION CHARACTERISTICS TYPICAL DESERT FANS 4–6 P.Z. ECOLOGICAL SITES

Growth Form	Composition
Grasses	10%
Forbs	10%
Shrubs	80%

2.5 Limy Hills 3–5 P.Z. Ecological Site Description

Limy Hills 3–5 P.Z. ecological sites in the TWE Project within the Las Vegas FO occur on fan remnants and alluvial fans on all exposures. Slopes range from 0% to 15%, but slope gradients of 2% to 8% are typical (NRCS 2020a). Major soil series associated with Limy Hills 3–5 P.Z. ecological sites include Haleburu, Crosgrain, Huevi, Hiller, St Thomas, and Iceberg. The climate in Limy Hills 3–5 P.Z. ecological sites is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. The climate is arid and is characterized by cool, moist winters and hot, dry summers. The relative humidity is low, evaporation is high, the percentage of sunshine is high, and the daily and seasonal range in temperature is wide. The average annual precipitation ranges from 3 to 5 inches.

2.5.1 Soil Characteristics

Limy Hills 3–5 P.Z. ecological sites are characterized as very deep, permeability is rapid to very rapid, and soils are typically well drained to excessively drained (Table I-11; NRCS 2020a). Topsoil textures include very gravelly fine sandy loam, very gravelly loamy sand, and very gravelly loamy coarse sand. Average topsoil depth is approximately 2.8 ± 2.2 inches. Desert pavement is common in this site. Subsoil textures are characterized as loamy. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0 \text{ dS/m}$), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table I-11).

TABLE I-11 SOIL CHARACTERISTICS TYPICAL OF LIMY HILLS 3–5 P.Z. ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed in mixed alluvium
Topsoil depth	2.8 ± 2.2 inches
Topsoil texture	Very gravelly fine sandy loam, very gravelly loamy sand, and very gravelly loamy coarse sand
Topsoil fragments	15%–65%
Topsoil pH	7.9–8.4
Topsoil salinity (EC)	0–16 dS/m
Topsoil sodicity (SAR)	0–10
Subsoil texture	Loamy
Subsoil fragments	10%–65%
Subsoil pH	7.9–8.5
Subsoil salinity (EC)	0–16 dS/m
Subsoil sodicity (SAR)	0–30

Sources: NRCS (2020a, 2020d)

2.5.2 Vegetation

Vegetative composition by growth forms in Limy Hills 3–5 P.Z. ecological sites is approximately 90% shrubs, 5% grasses and grass-like plants, and 5% forbs (Table I-12; NRCS 2020a). The dominant grasses that may occur in Limy Hills 3–5 P.Z. ecological sites include Indian ricegrass, threeawn, low woollygrass (*Dasyochloa pulchella*) and big galleta. Dominant woody plants found at this site include burrobush and creosote bush. Secondary woody species include brittlebush and Fremont's dalea.

TABLE I-12 VEGETATION CHARACTERISTICS TYPICAL OF LIMY HILLS 3–5 P.Z. ECOLOGICAL SITES

Growth Form	Composition
Grasses	5%
Forbs	5%
Shrubs	90%

Source: NRCS (2020a)

2.6 Steep Stony Slopes Ecological Site Description

Steep Stony Slopes ecological sites in the TWE Project within the Las Vegas FO occur on south-facing hill and mountain slopes at elevations of 2100 to 4900 feet. Slopes are typically 30% to 60% but may range from 8% to 60% (NRCS 2020a). Major soil series associated with Steep Stony Loams ecological sites include Iceberg, St. Thomas, Nipton, Huleburu, and Sunrock. The climate in Steep Stony Slopes

ecological sites is characterized by hot temperatures, aridity, and a bimodal precipitation pattern. The average annual precipitation ranges from 3 to 5 inches.

2.6.1 Soil Characteristics

Steep Stony Slopes ecological sites are characterized as very deep, permeability is rapid, and soils are typically somewhat excessively drained (Table I-13; NRCS 2020a). Topsoil textures include gravelly sand or very gravelly loamy sand with gravelly loamy sand subsurface. Average topsoil depth is approximately 1.7 ± 0.3 inches. Subsoil textures are characterized as sandy. Soil pH ($\text{pH} > 8.4$), salinity ($\text{EC} > 4.0$ dS/m), and sodicity ($\text{SAR} > 12.0$) may limit vegetation growth in some areas (see Table I-13).

TABLE I-13 SOIL CHARACTERISTICS TYPICAL OF STEEP STONY SLOPES ECOLOGICAL SITES

Soil Characteristics	Description
Parent material	Formed from alluvium derived from granitoid and/or residuum weathered from granitoid
Topsoil depth	1.7 ± 0.3 inches
Topsoil texture	Gravelly sand or very gravelly loamy sand with gravelly loamy sand subsurface
Topsoil fragments	30%–70%
Topsoil pH	6.6–8.4
Topsoil salinity (EC)	0–2 dS/m
Topsoil sodicity (SAR)	0–4
Subsoil texture	Sandy
Subsoil fragments	15%–50%
Subsoil pH	6.6–8.4
Subsoil salinity (EC)	0–2 dS/m
Subsoil sodicity (SAR)	0–4

Sources: NRCS (2020a, 2020d)

2.6.2 Vegetation

Vegetative composition by growth forms in Steep Stony Slopes ecological sites is approximately 70% shrubs, 5% grasses and grass-like plants, and 25% forbs (Table I-14; NRCS 2020a). The dominant grass that may occur in Steep Stony Loams ecological sites is big galleta. Dominant woody plants found at this site include brittlebush, creosote bush, Mojave yucca, burrobush, water jacket (*Lycium andersonii*), jojoba (*Simmondsia chinensis*), Parish's goldeneye (*Viguiera parishii*), California barrel cactus (*Ferocactus cylindraceus*) and white ratany (*Krameria grayi*). Forbs that can be found at Steep Stony Loams ecological sites include brittle spineflower (*Chorizanthe brevicornu*), pincushion flower (*Chaenactis fremontii*), whisperingbells (*Emmenanthe penduliflora*), desert trumpet (*Eriogonum inflatum*), desert poppy (*Eschscholzia glyptosperma*), lacy phacelia (*Phacelia tanacetifolia*), sand fringe pod (*Thysanocarpus curvipes*), desert globemallow (*Sphaeralcea ambigua*), brownplume wirelettuce (*Stephanomeria pauciflora*), Mojave woodyaster (*Xylorhiza tortifolia*), and redstem stork's bill (*Erodium cicutarium*).

TABLE I-14 VEGETATION CHARACTERISTICS TYPICAL STEEP STONY SLOPES ECOLOGICAL SITES

Growth Form	Composition
Grasses	5%
Forbs	25%
Shrubs	70%

Source: NRCS (2020a)

ATTACHMENT I-1

Las Vegas Field Office Photographs



Figure I-1-1 **Representative Desert Fans 4–6 P.Z. in the Las Vegas FO. Site ID 1025RD01.**



Figure I-1-2 **Representative Limy Hill 3–5 P.Z. in the Las Vegas FO. Site ID 1024RD01.**



Figure I-1-3 Representative Loamy Bottom in the Las Vegas FO. Site ID 1219AF04.



Figure I-1-4 Representative Saline Bottom in the Las Vegas FO. Site ID 0916RD01.



Figure I-1-5 **Representative Steep Stony Loams in the Las Vegas FO. Site ID 0316RD04.**



Figure I-1-6 **Representative Valley Wash in the Las Vegas FO. Site ID 0319RD06.**

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ATTACHMENT I-2

Las Vegas Field Office Maps

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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- Survey Data Locations

Ecological Classification Name

- Desert Fans 4-6 P.Z.

Jurisdiction

- BLM
- BLM Field Office

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Feet
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Source: BLM 2015



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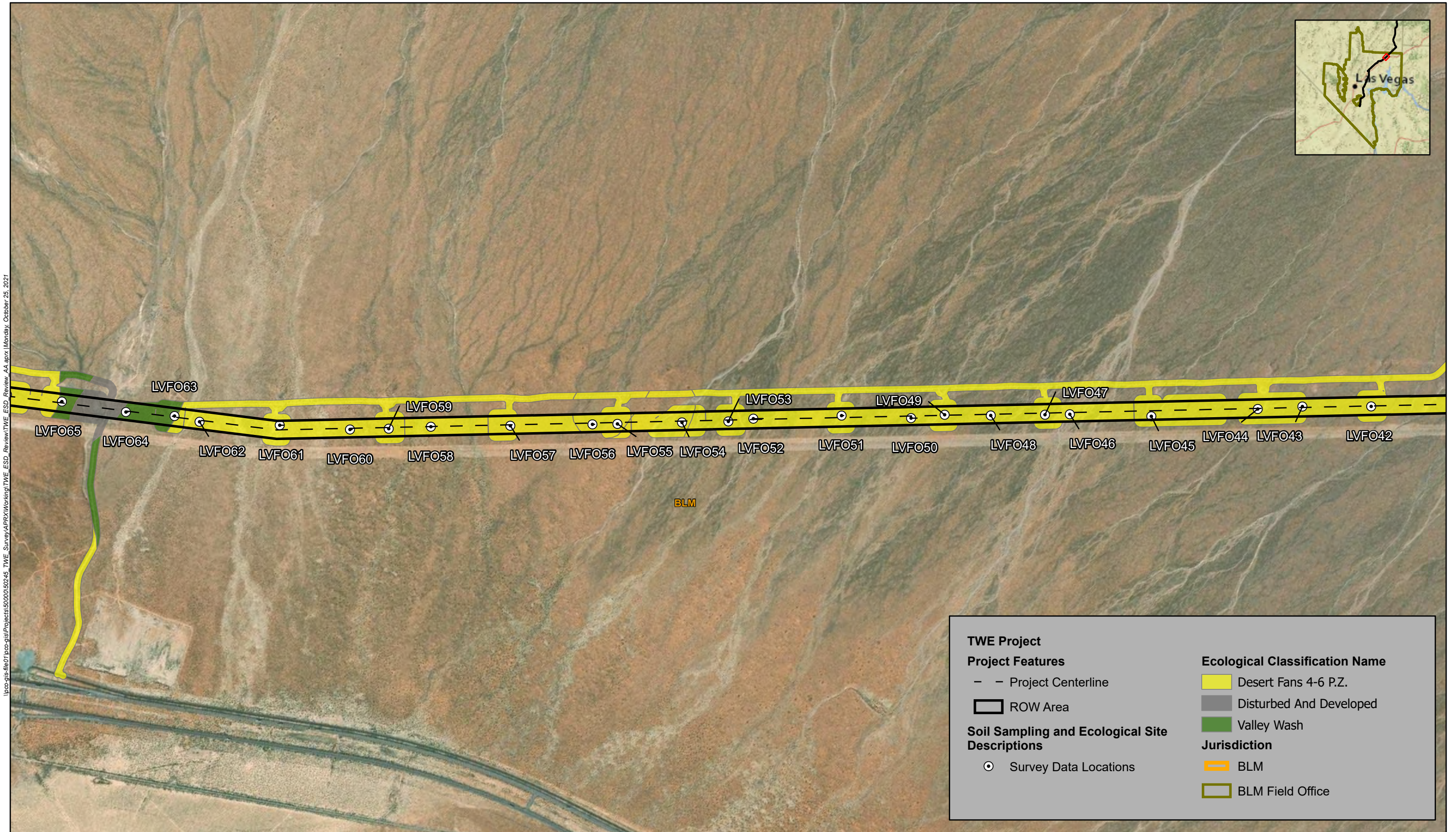
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Source: BLM 2015

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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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Source: BLM 2015

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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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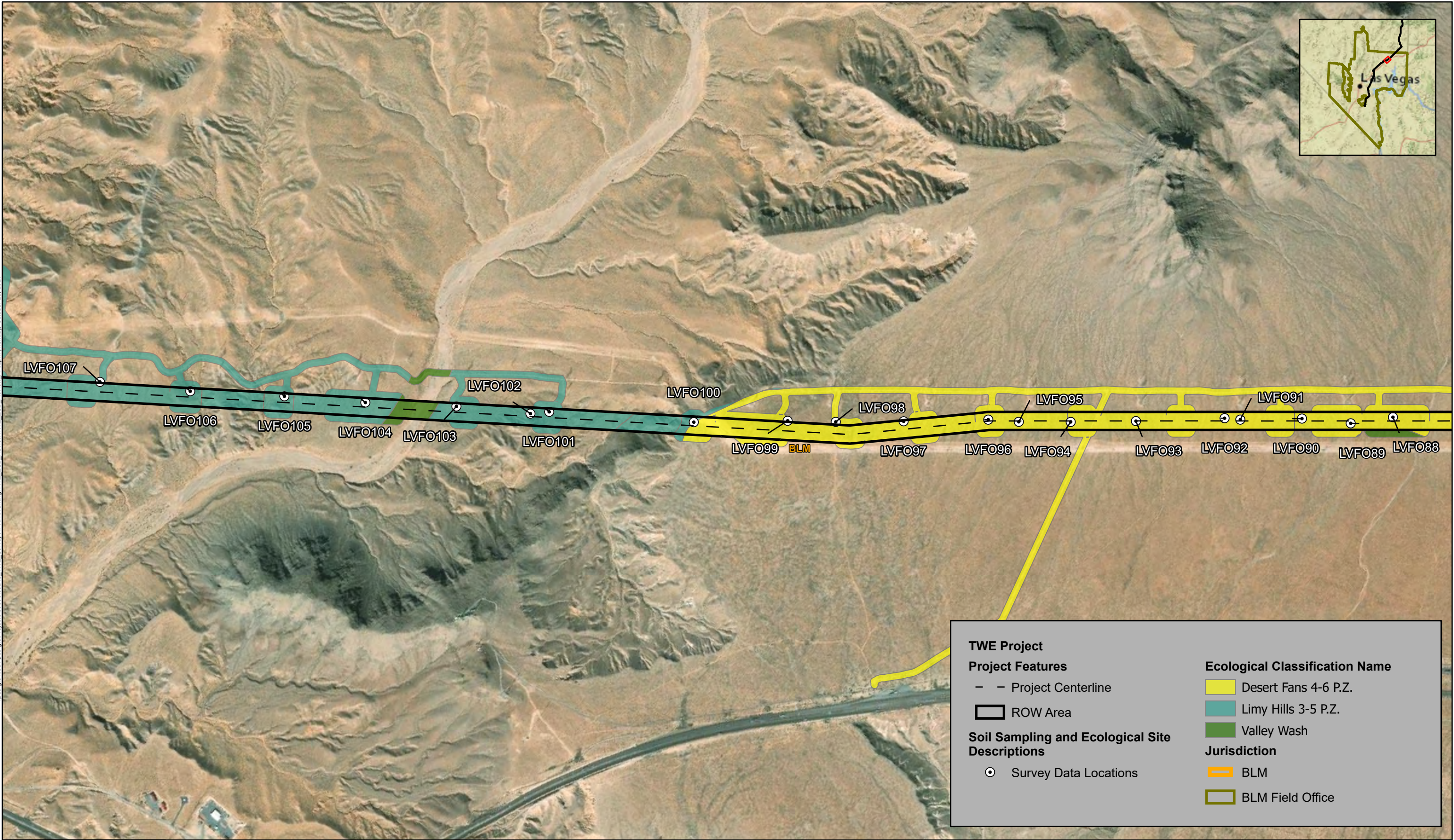
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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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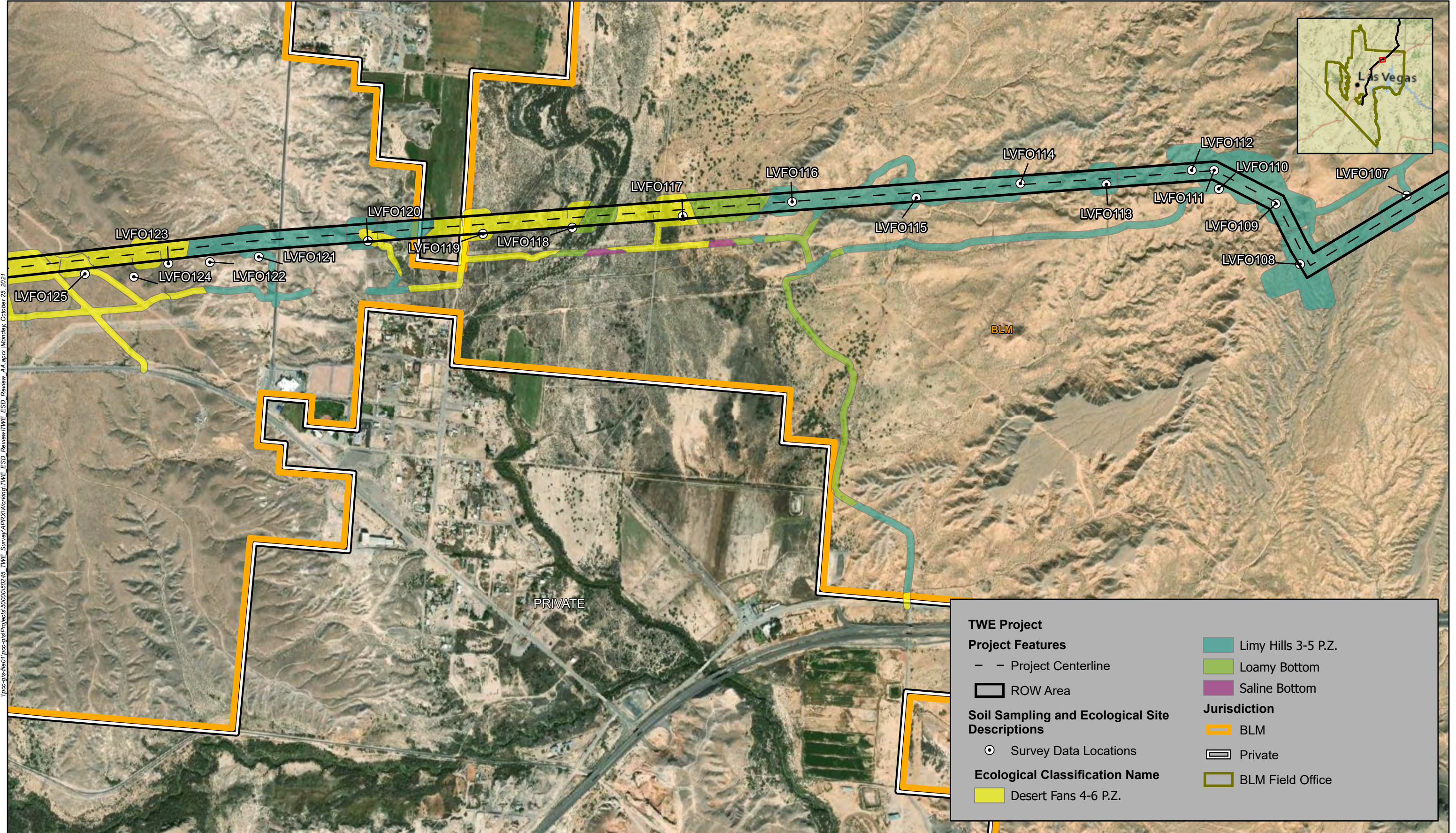


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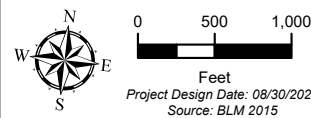
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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project





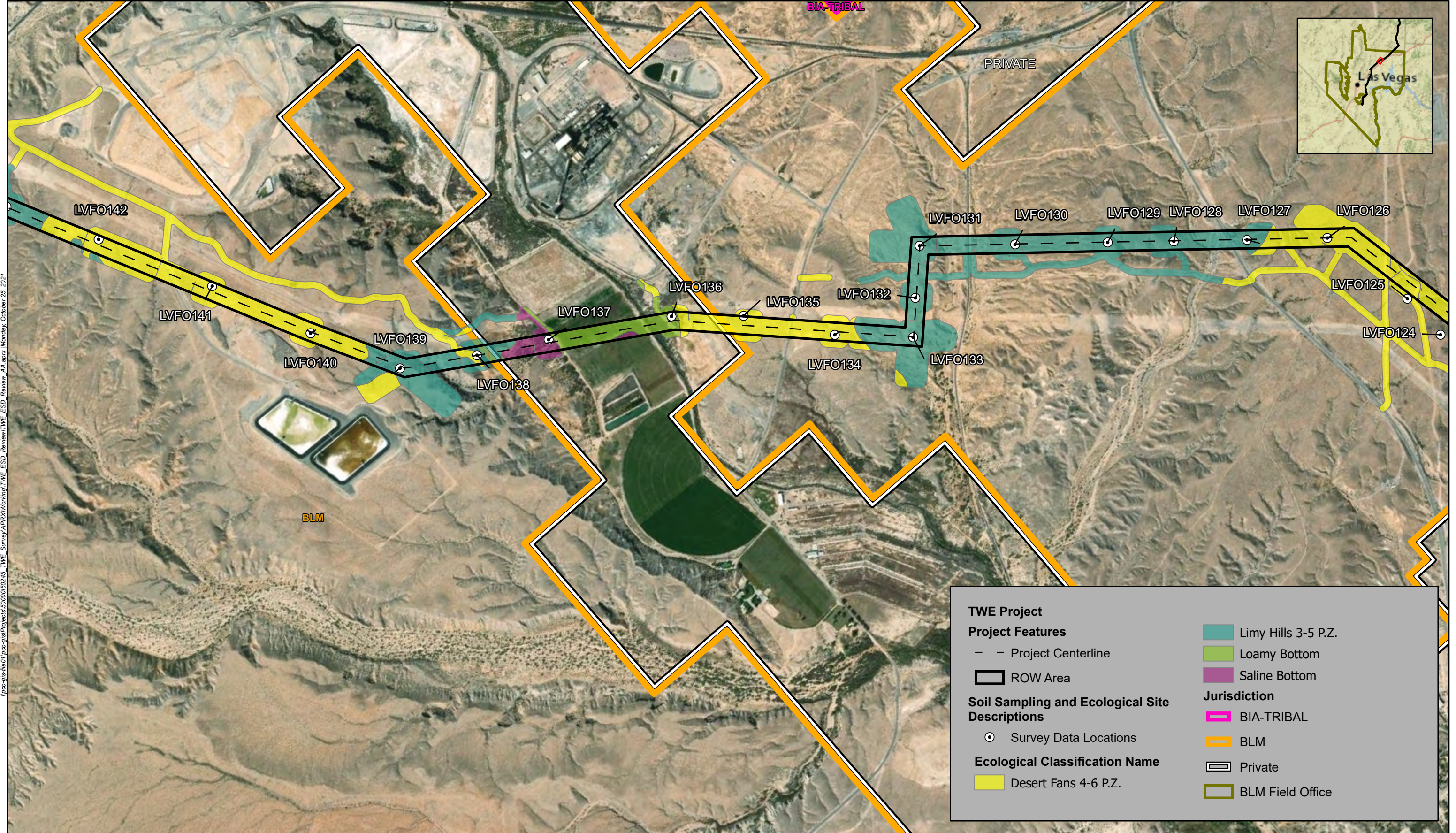
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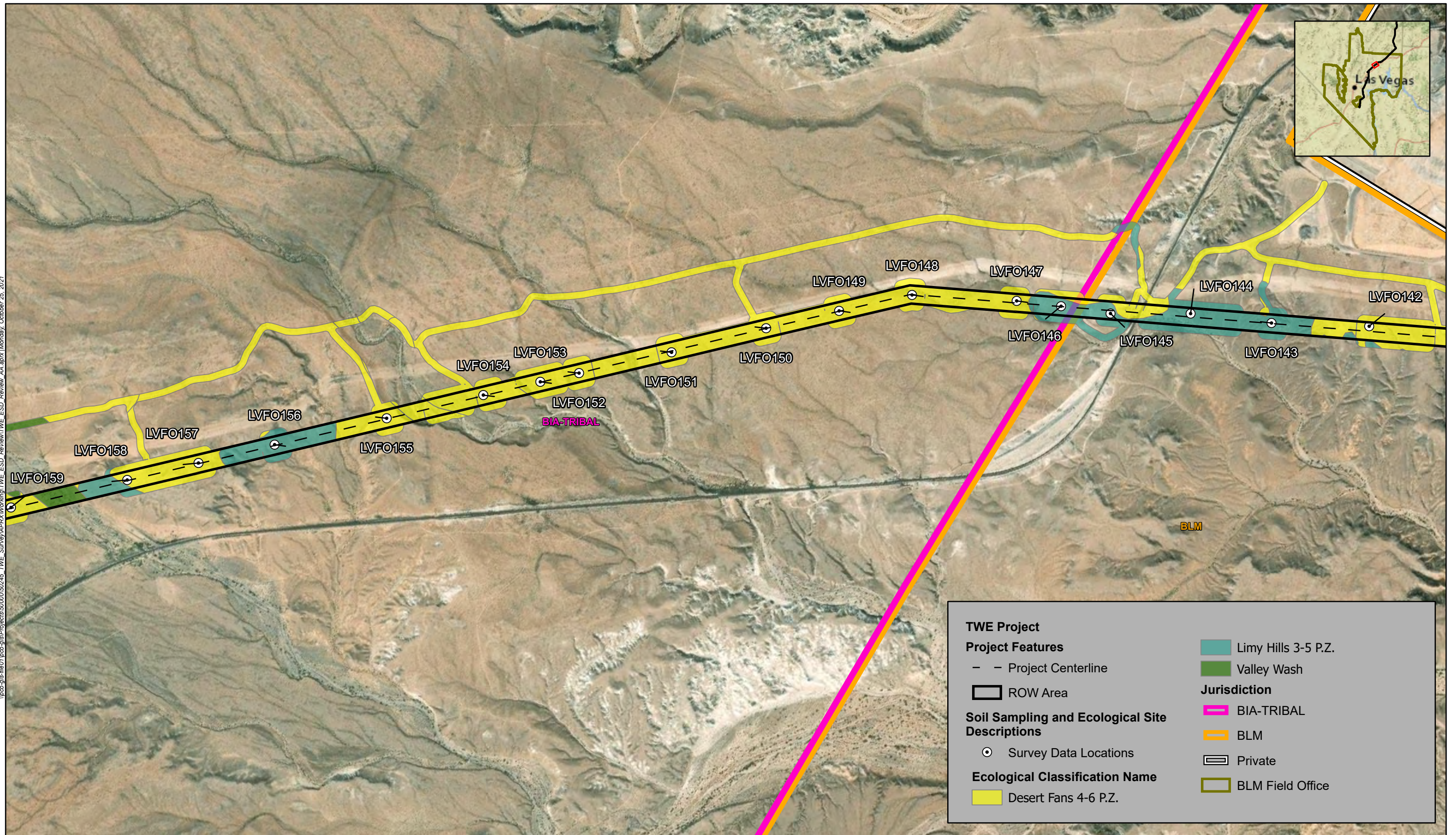
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TWE Project	
Project Features	
- - Project Centerline	
□ ROW Area	
Soil Sampling and Ecological Site Descriptions	
○ Survey Data Locations	
Ecological Classification Name	
■ Desert Fans 4-6 P.Z.	
■ Limy Hills 3-5 P.Z.	
■ Loamy Bottom	
■ Saline Bottom	
Jurisdiction	
■ BLM	
■ Private	
■ BLM Field Office	



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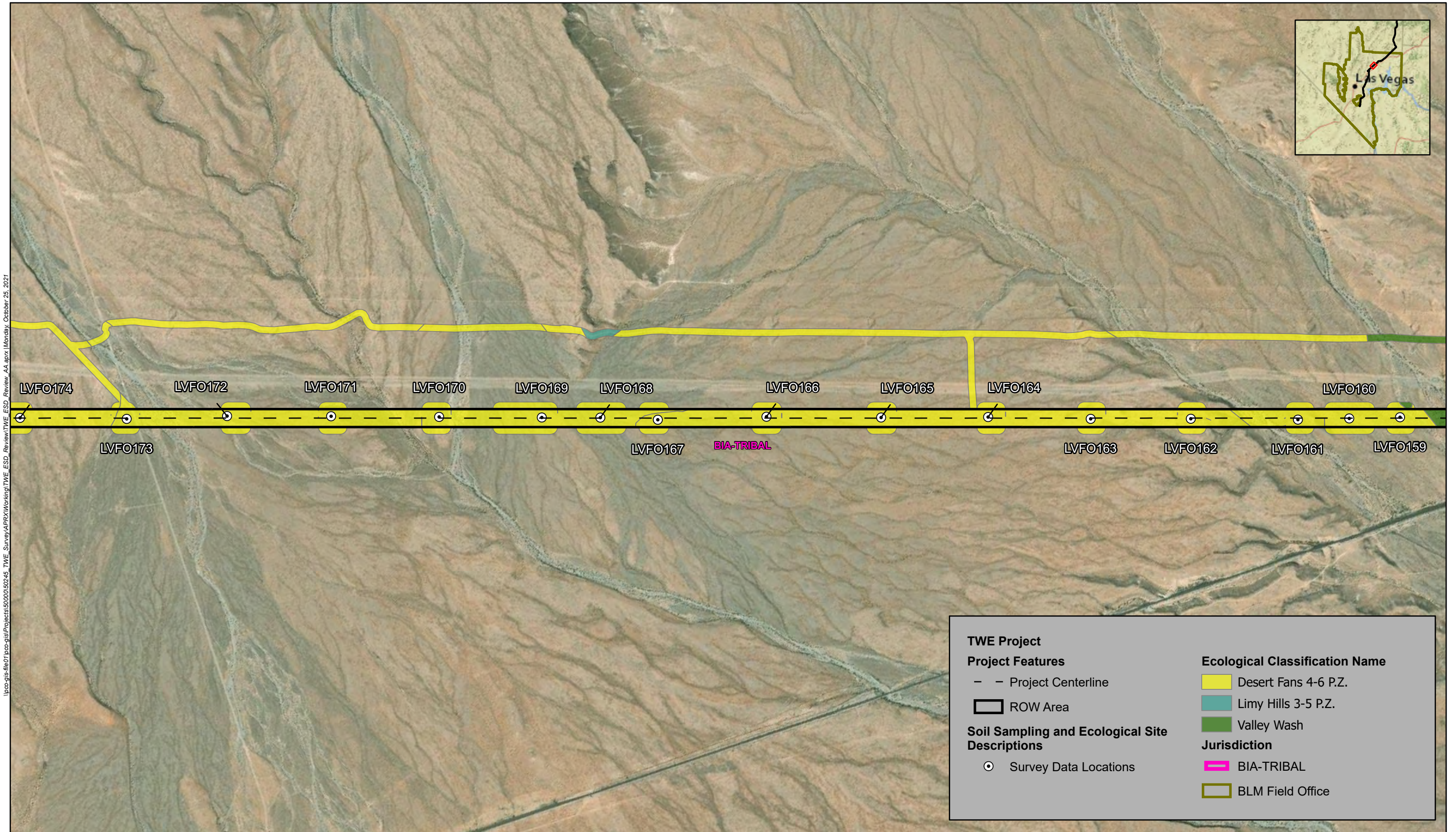
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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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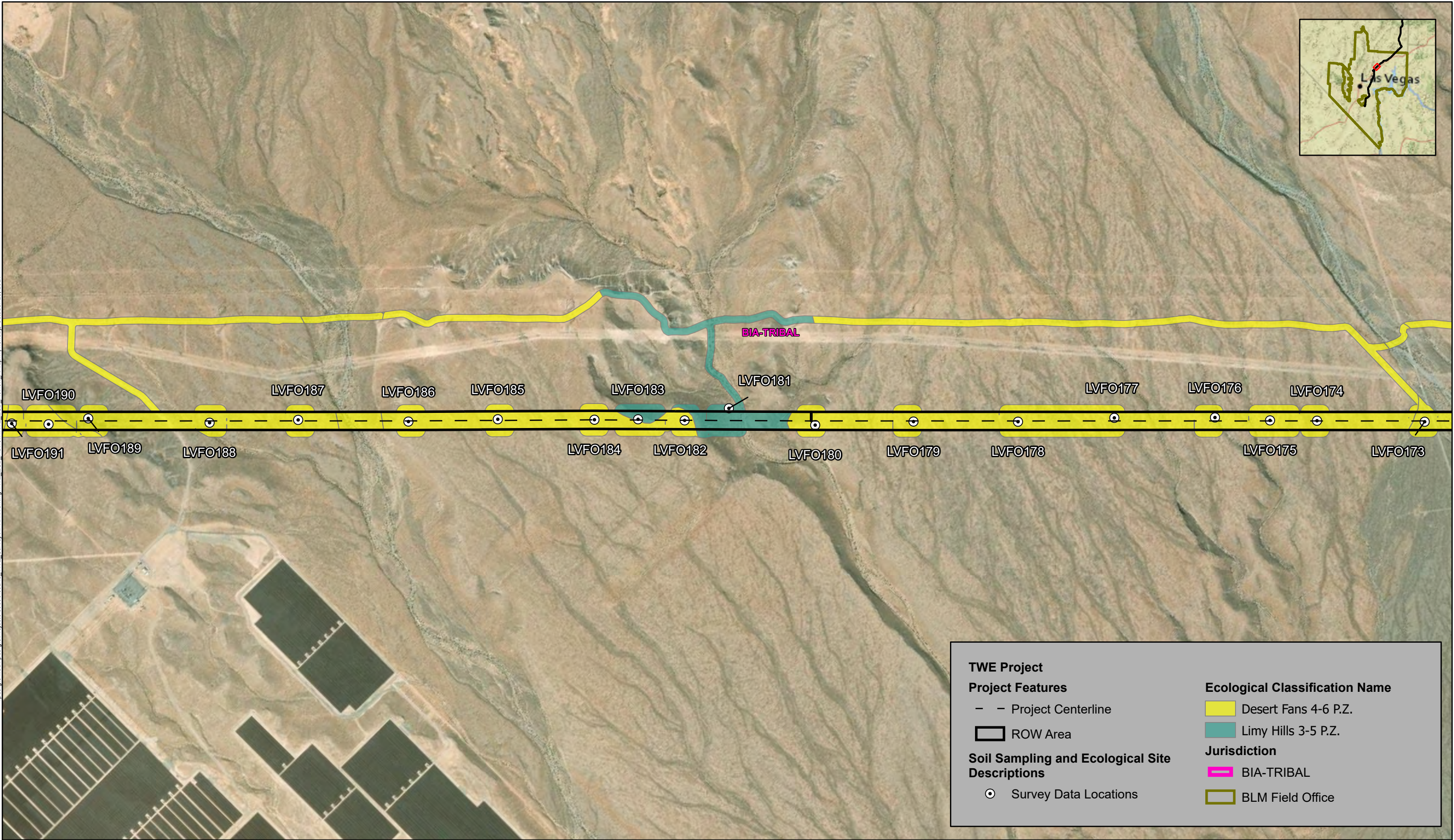
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Source: BLM 2015

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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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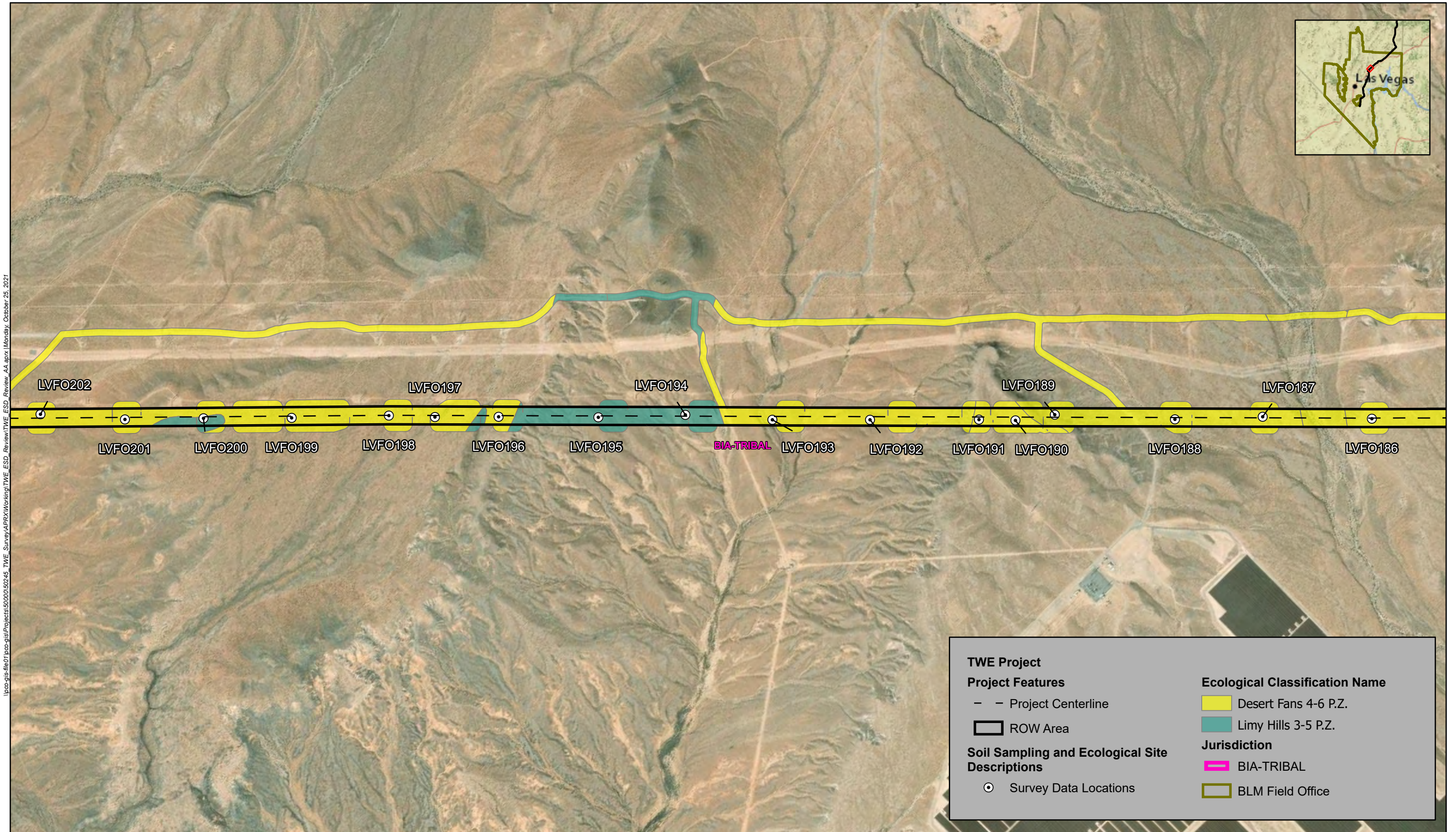
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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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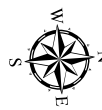
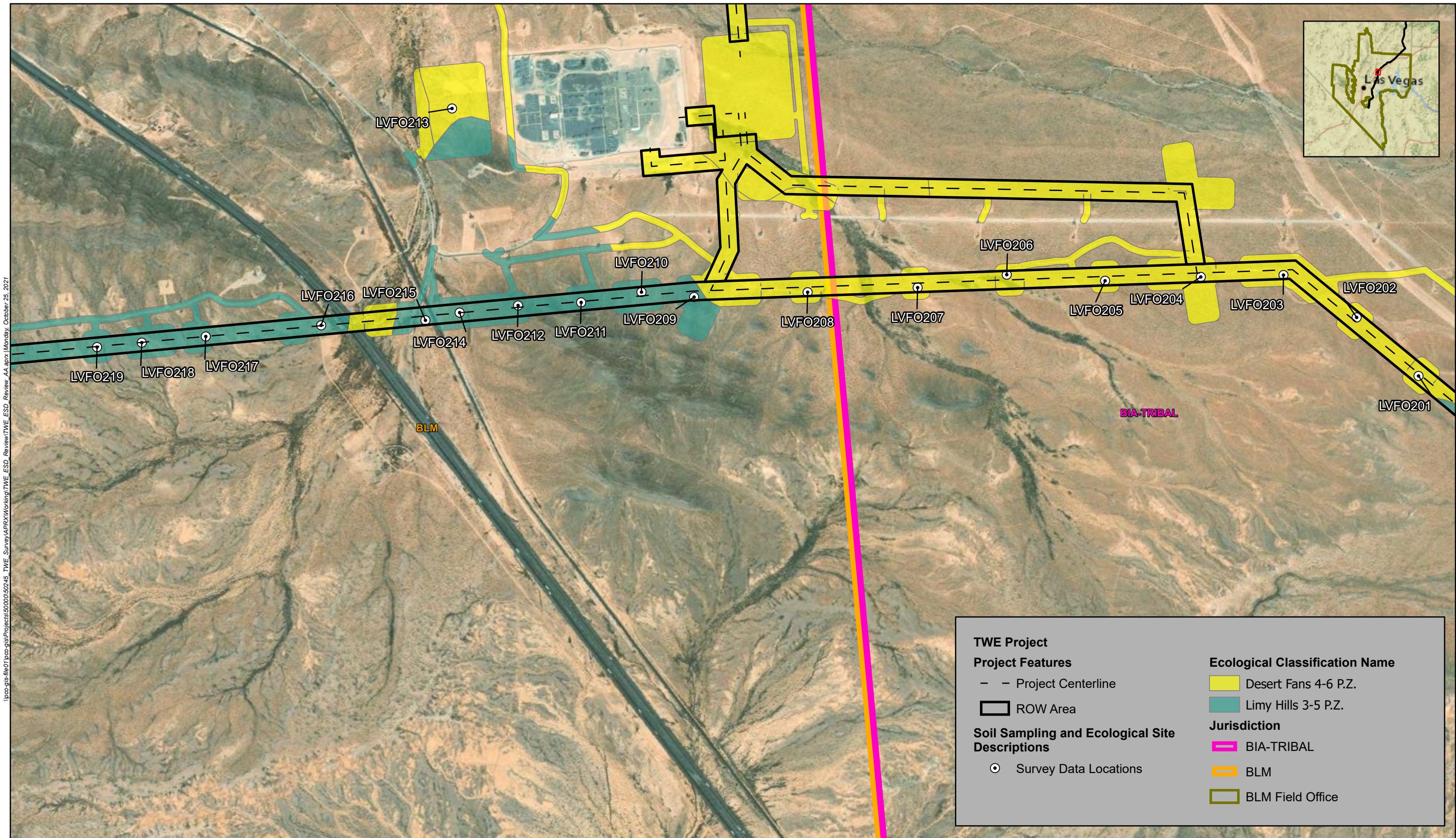
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Source: BLM 2015

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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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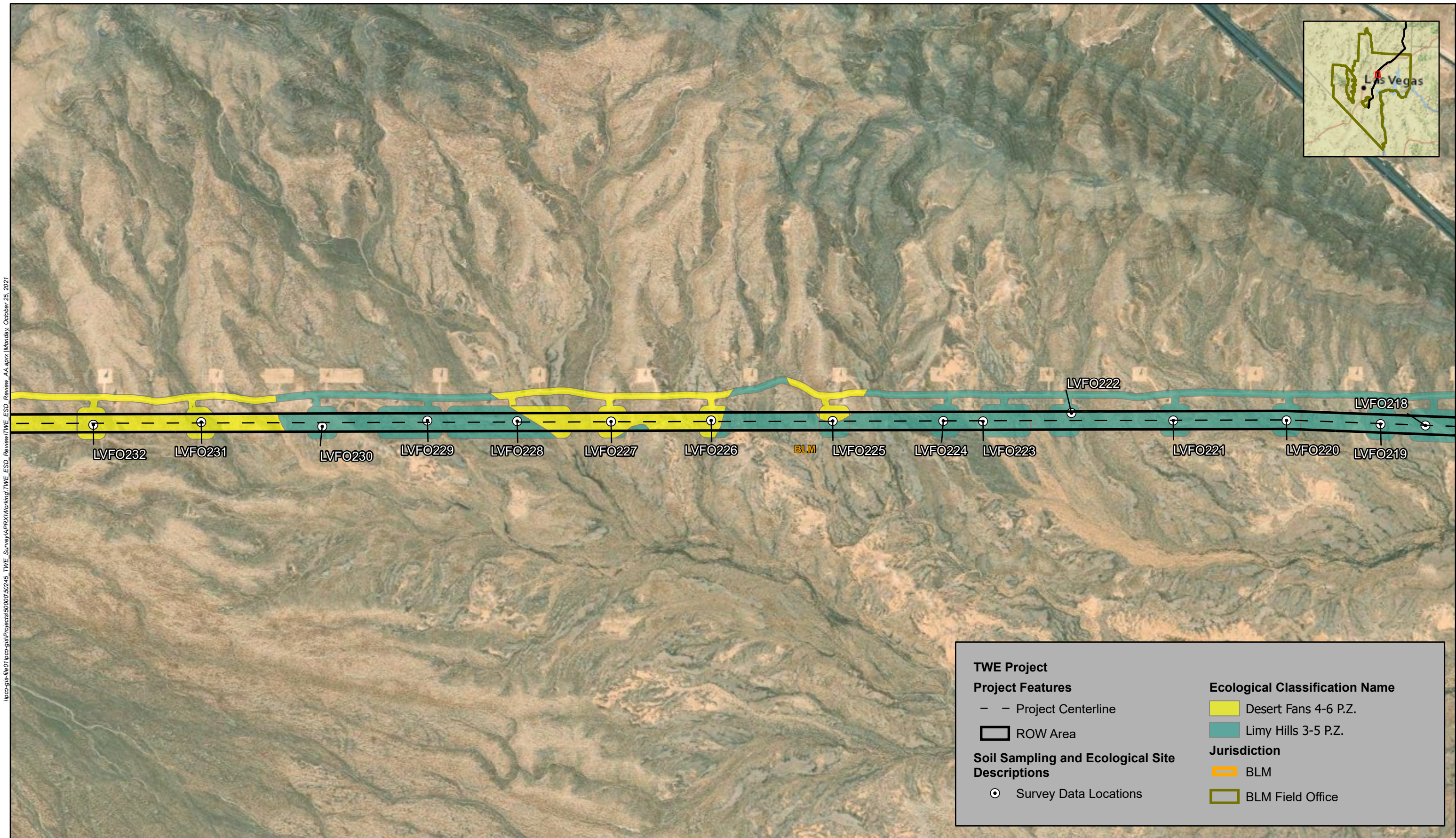
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Source: BLM 2015

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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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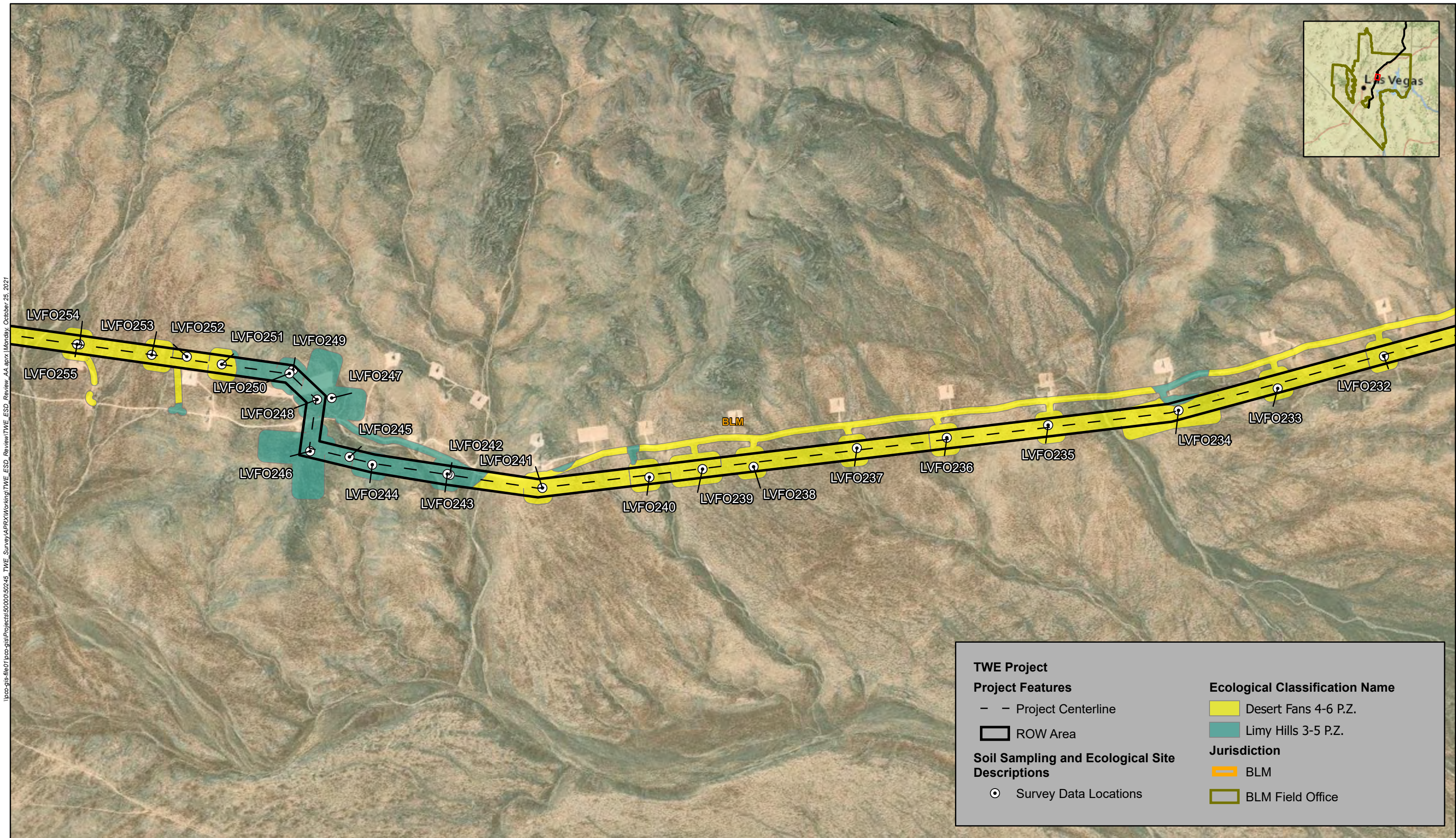
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Source: BLM 2015

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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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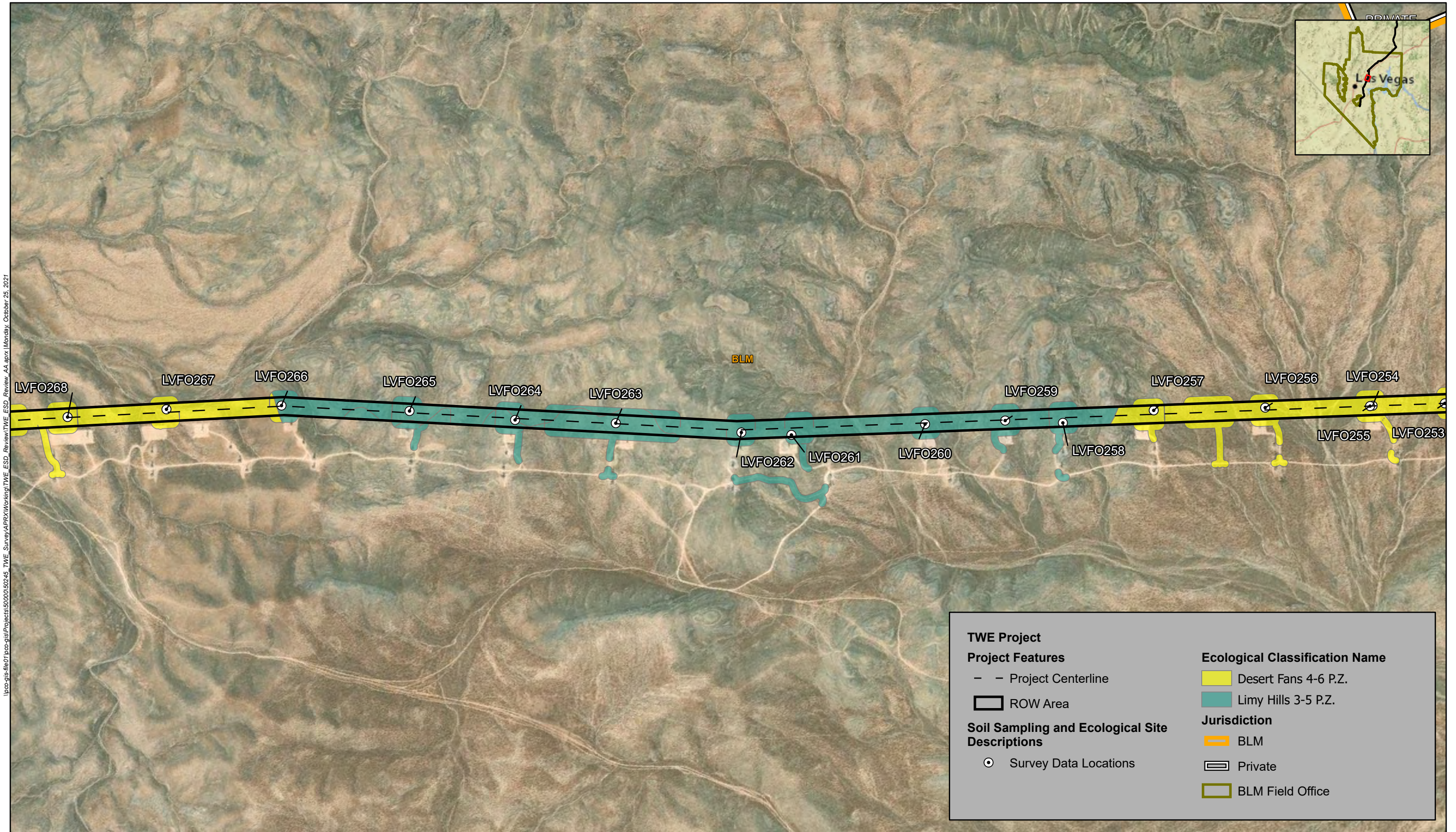
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Ecological Site Descriptions - Las Vegas Field Office
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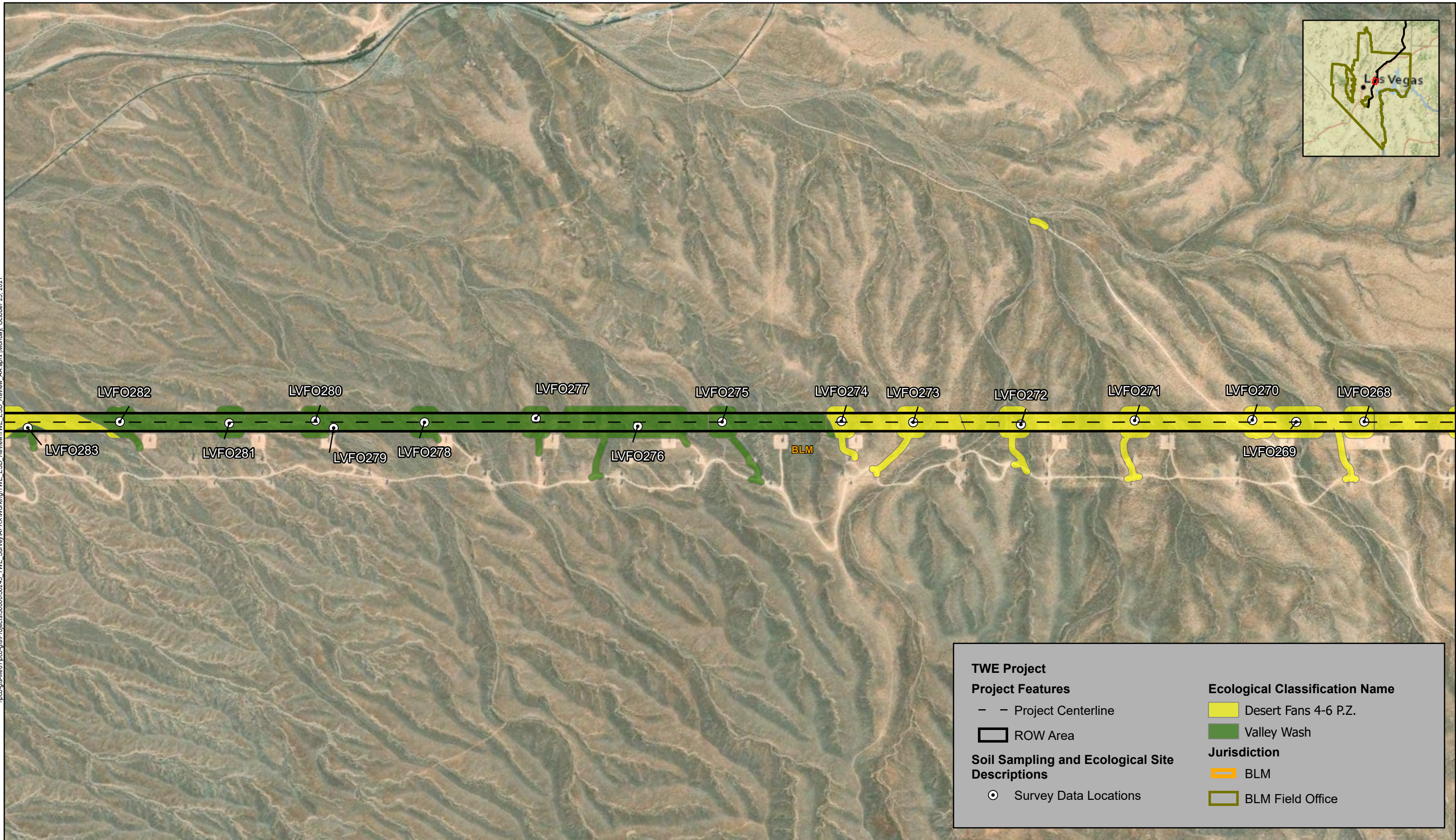
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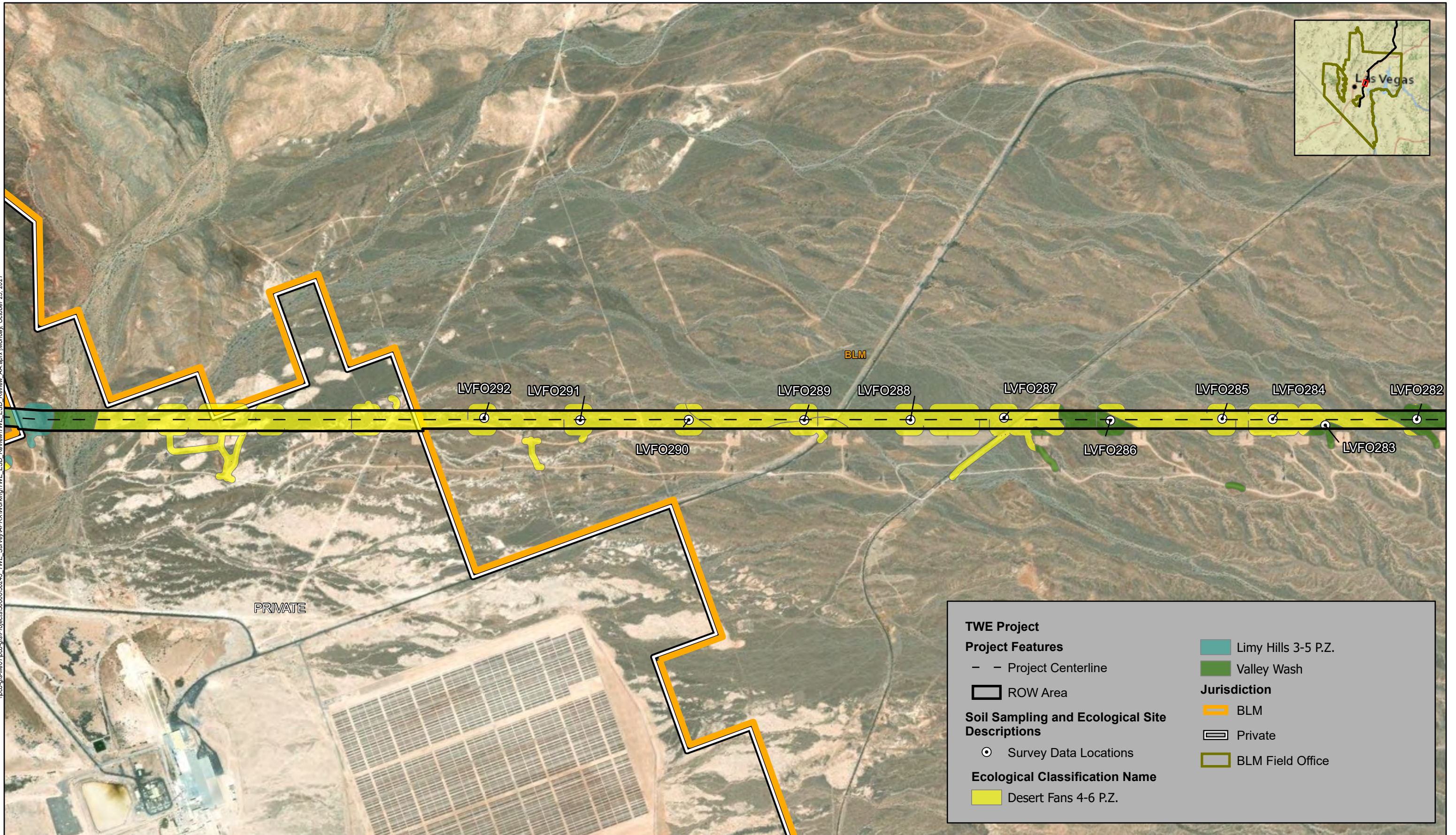
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TransWest Express Transmission Project



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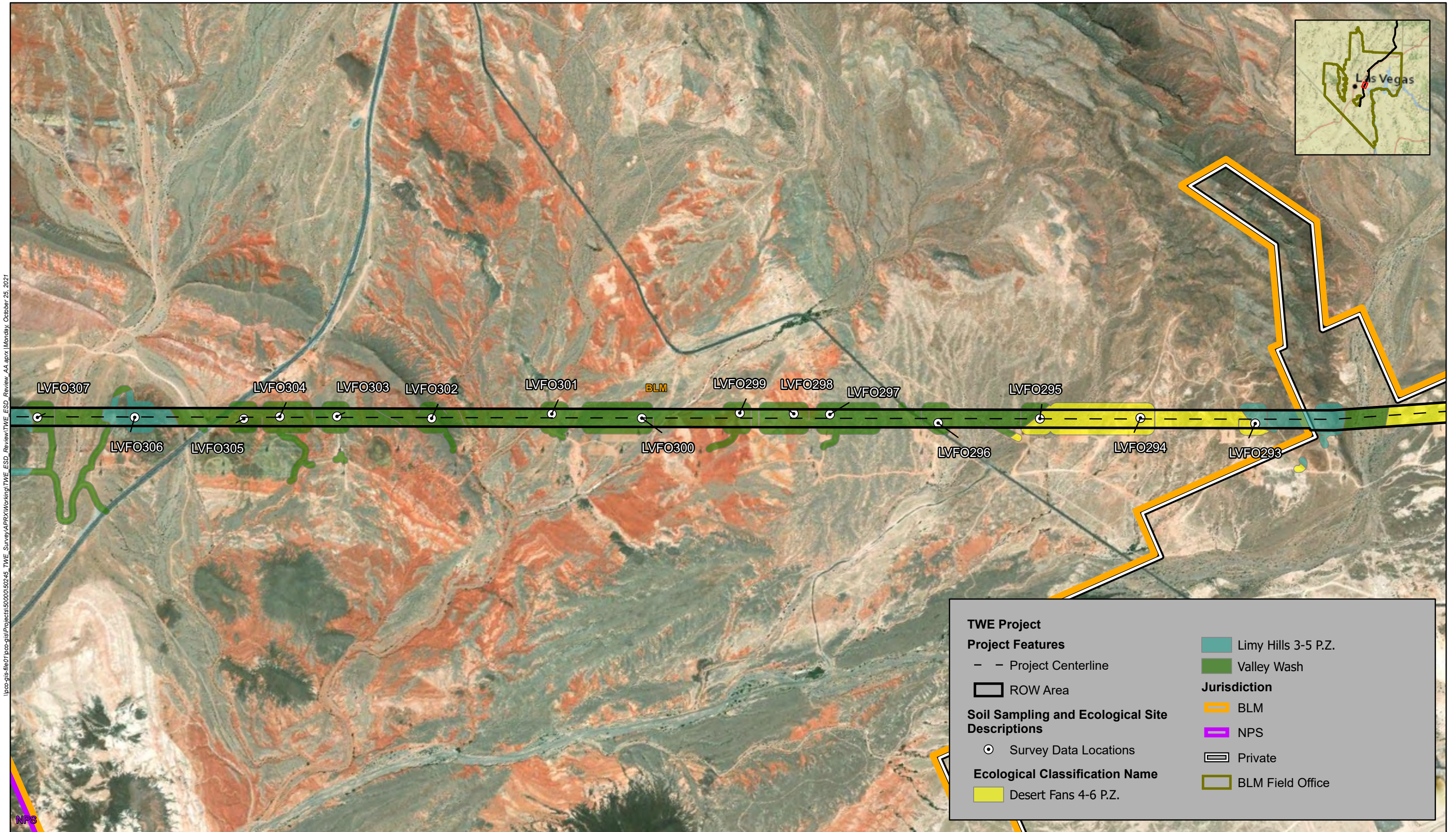
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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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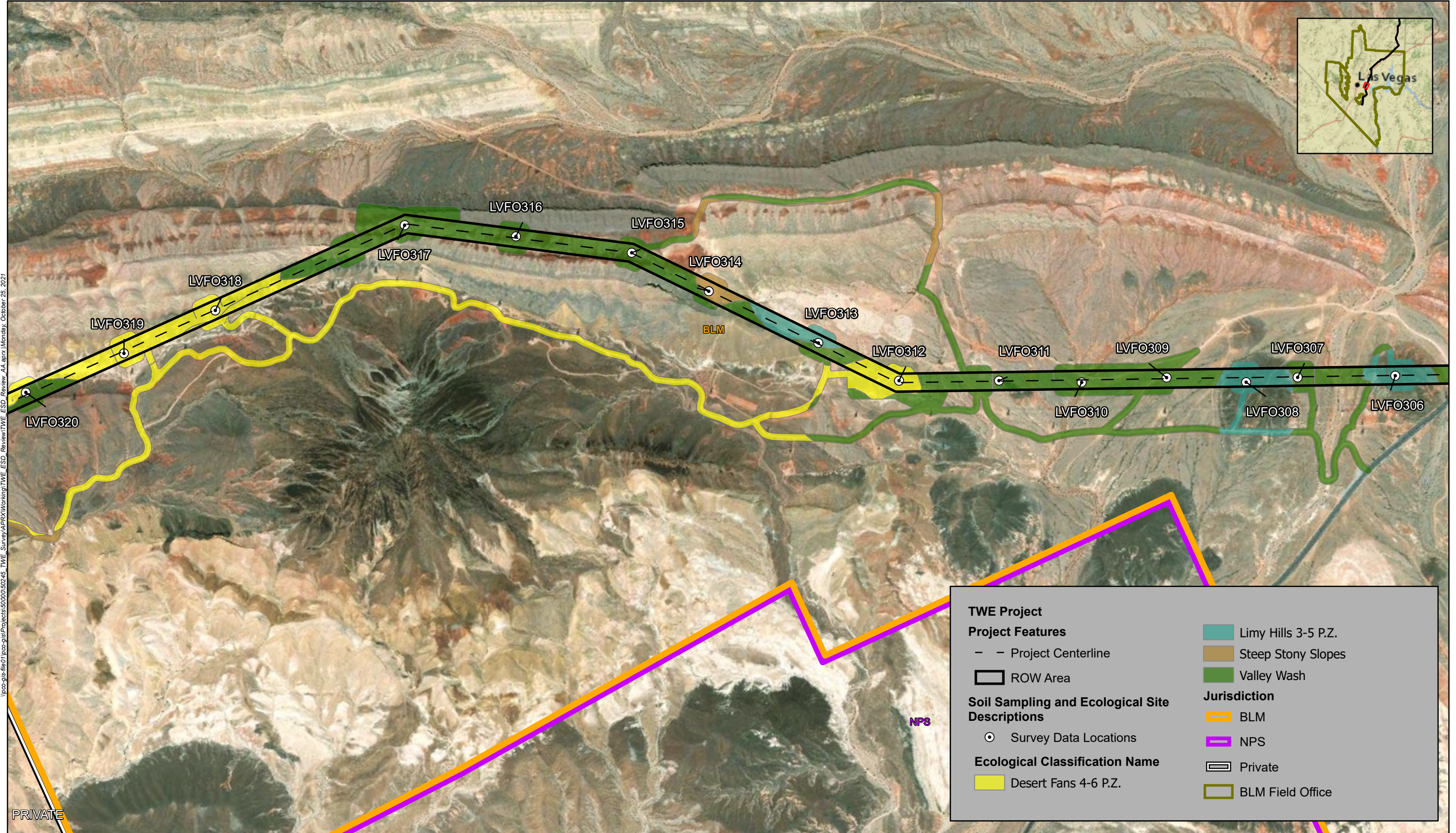
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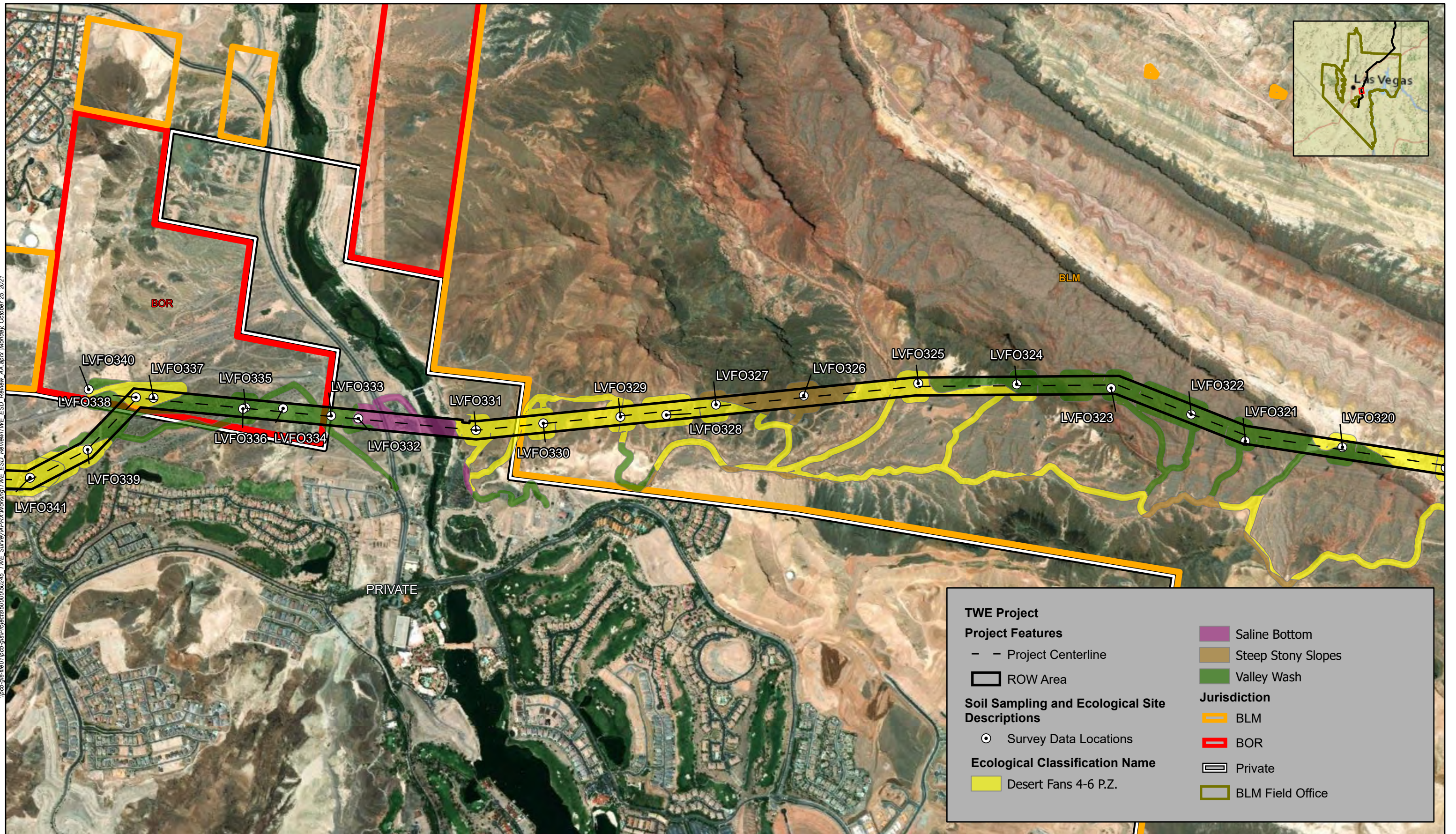


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TWE Project

Project Features

- - Project Centerline
- ▭ ROW Area

Soil Sampling and Ecological Site Descriptions

- Survey Data Locations

Ecological Classification Name

- Desert Fans 4-6 P.Z.

- Saline Bottom
- Steep Stony Slopes
- Valley Wash

Jurisdiction

- BLM
- BOR
- Private
- BLM Field Office

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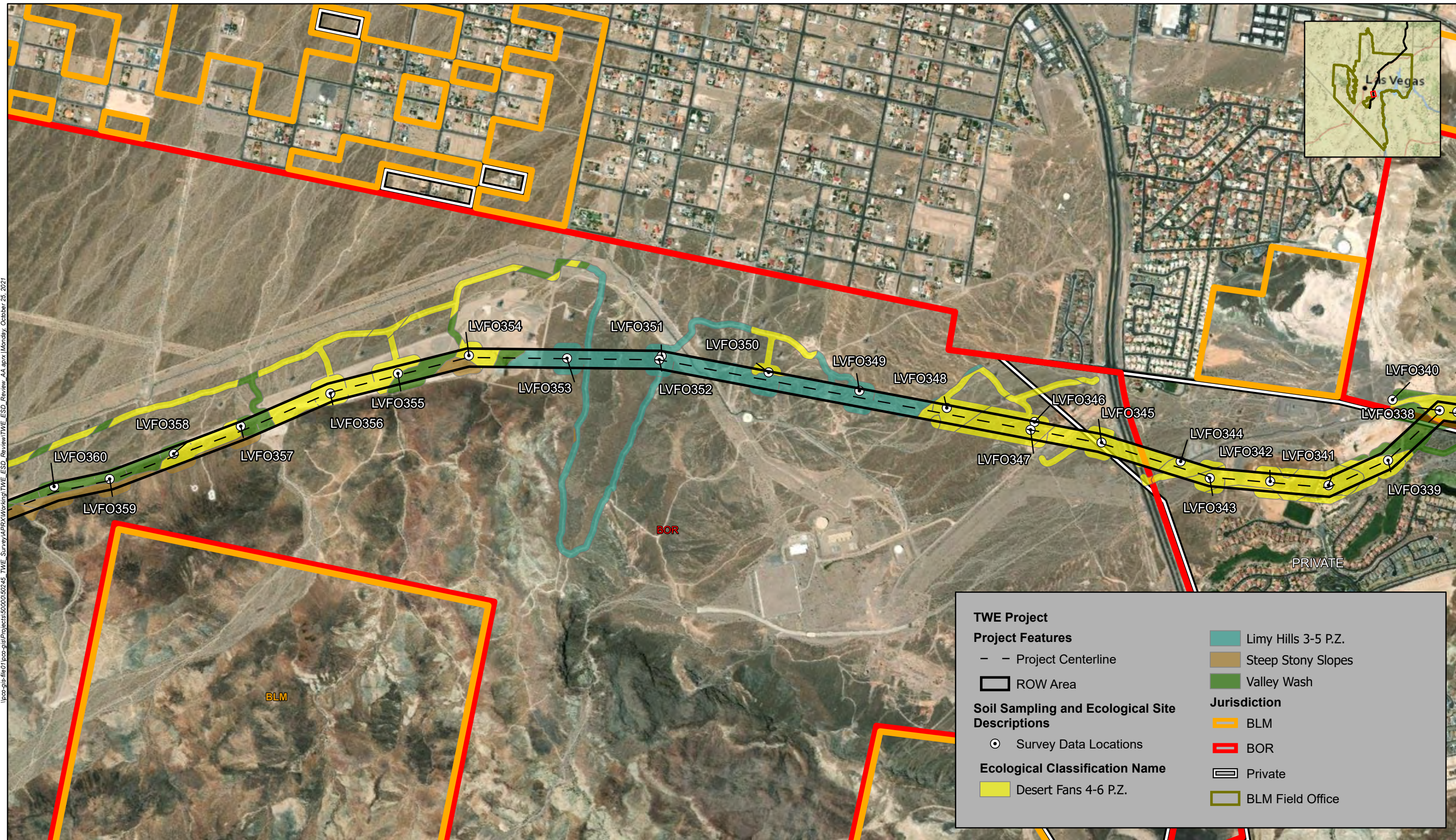
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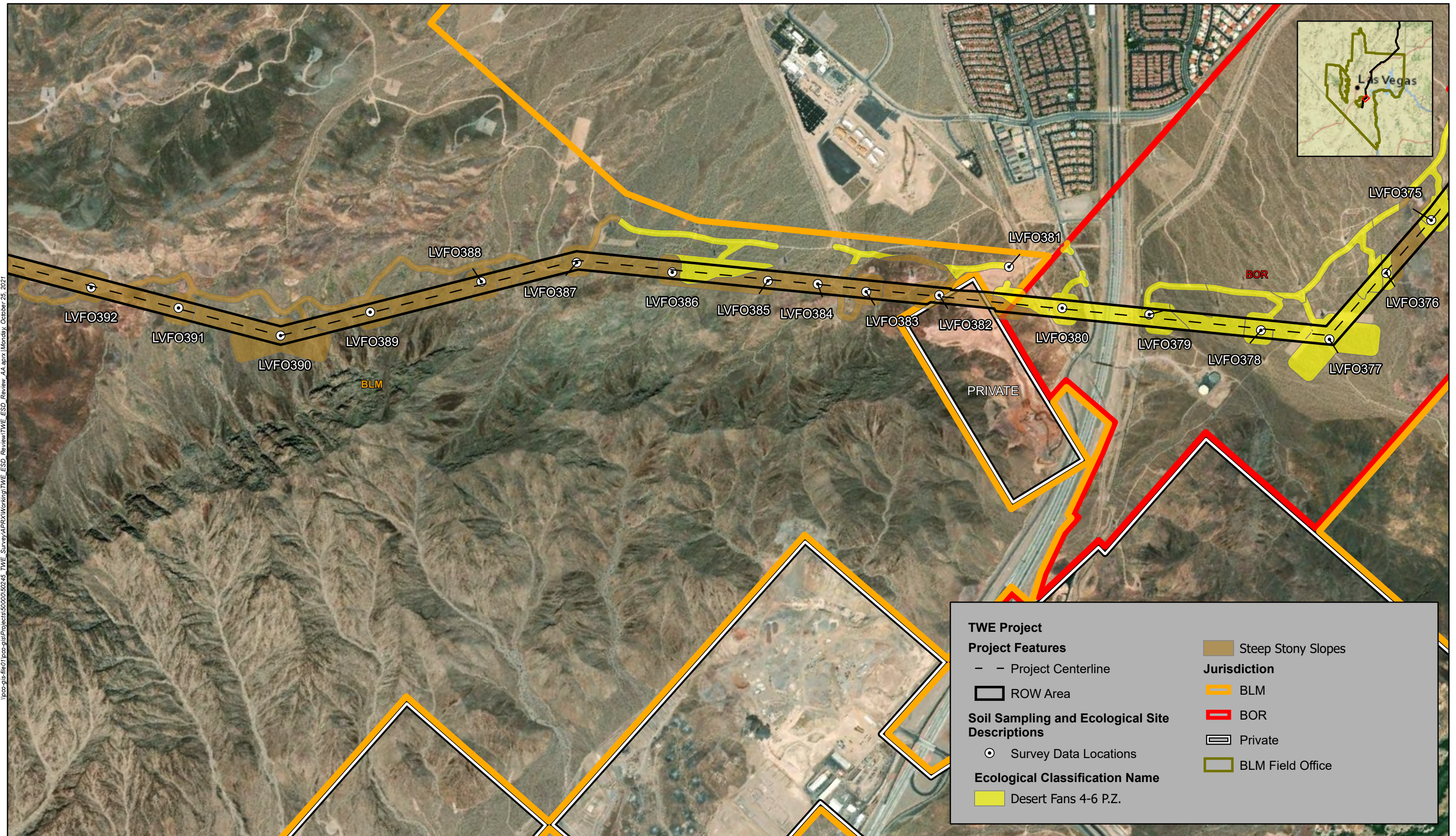
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TransWest Express Transmission Project



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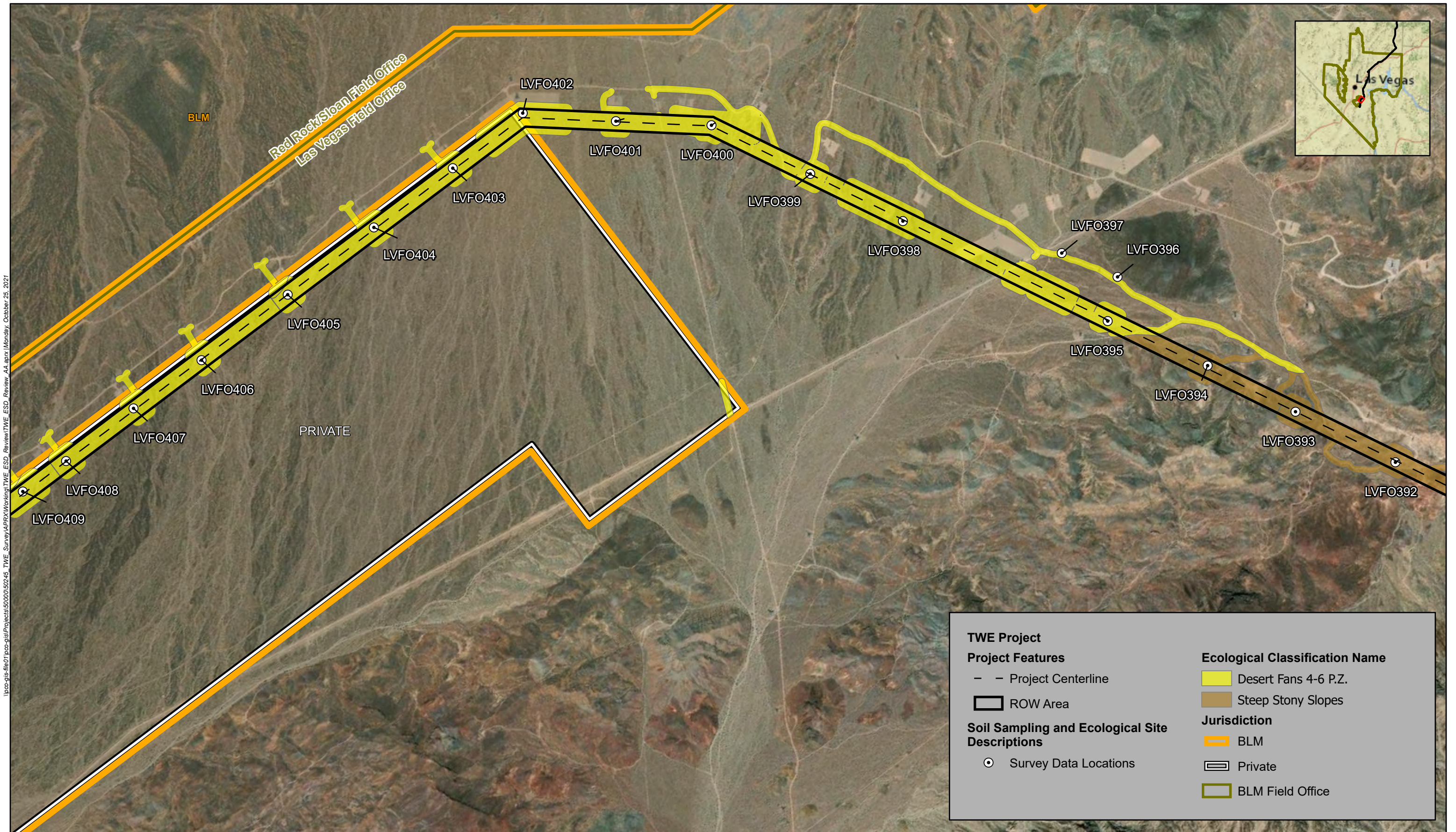
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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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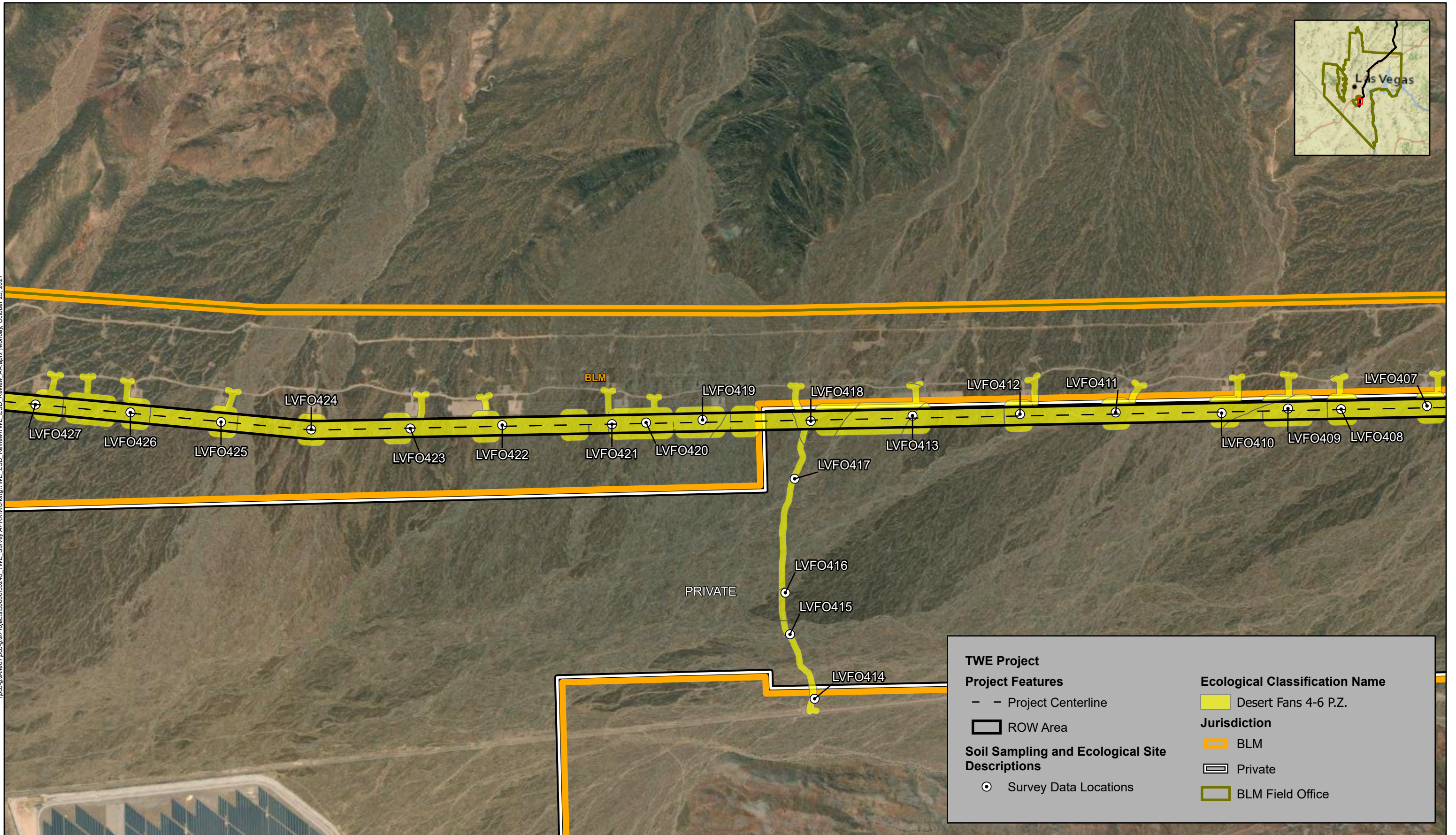
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Ecological Site Descriptions - Las Vegas Field Office
TransWest Express Transmission Project



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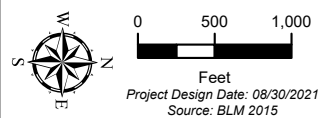
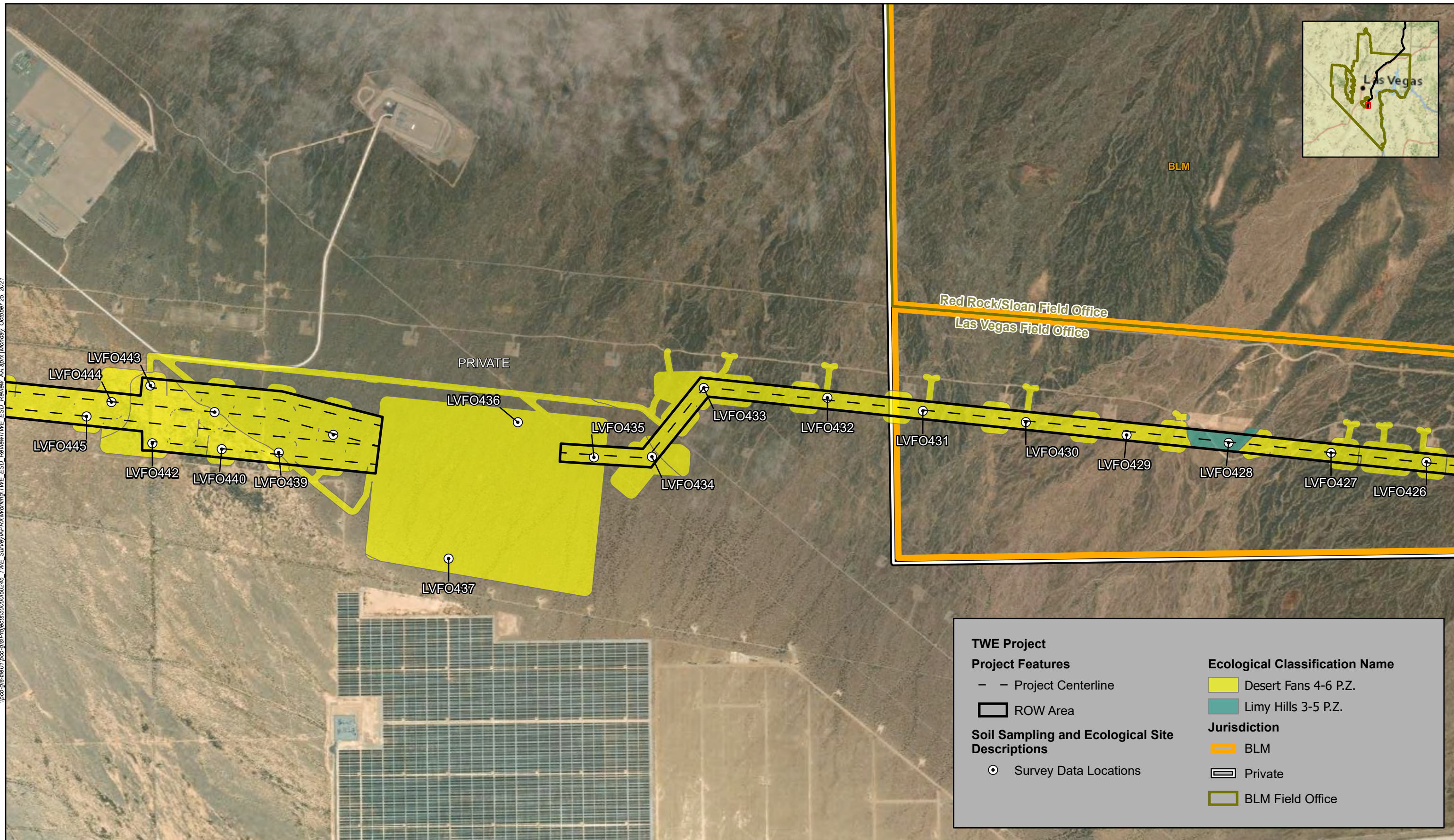
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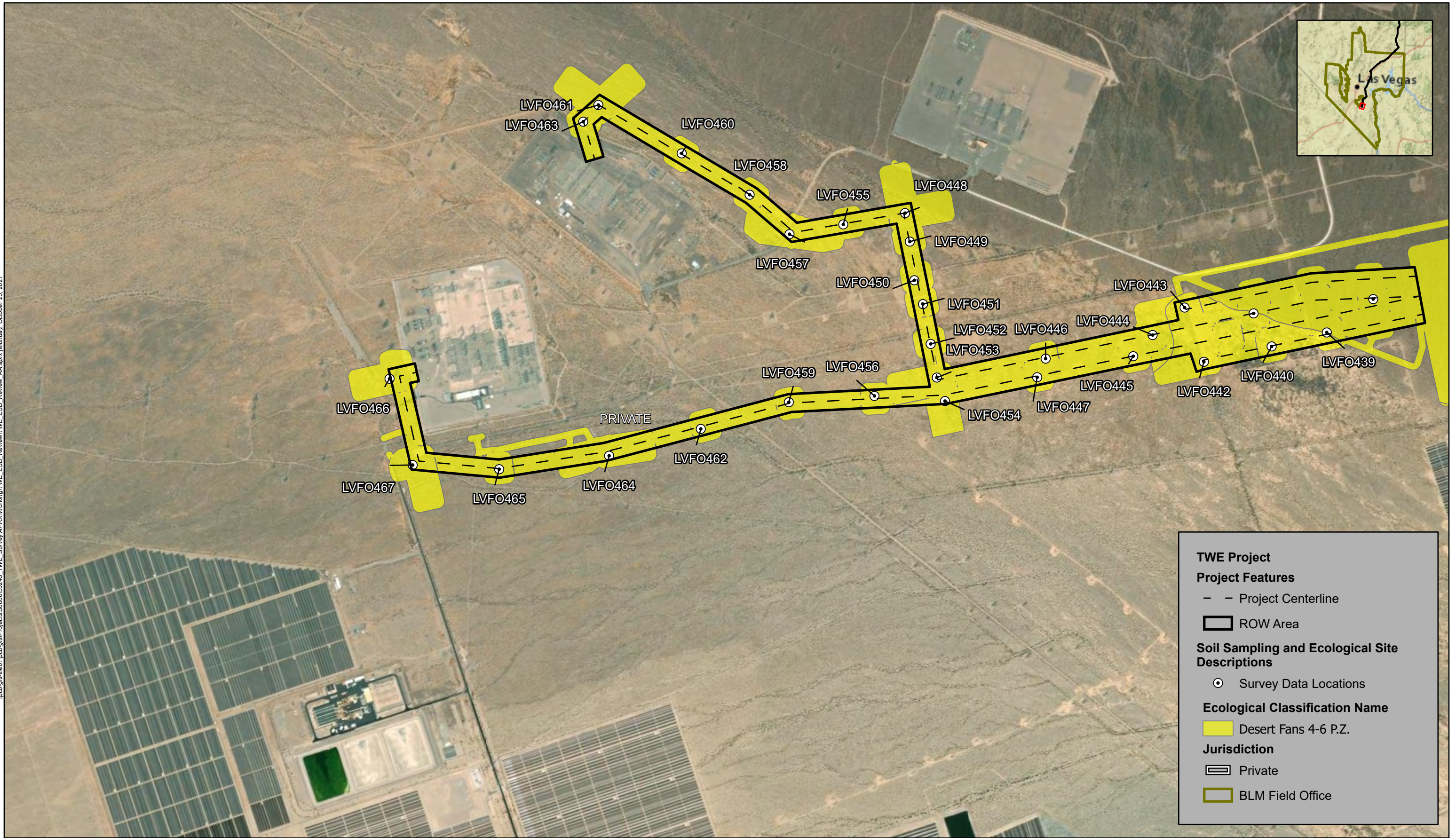
Ecological Site Descriptions - Las Vegas Field Office
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Ecological Site Descriptions - Las Vegas Field Office
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